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---

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L. W. SMITH, Treasurer, Parsonage Road, Metuchen, N. J.

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ARTICLES

MALARIA ERADICATION AND POSTAGE STAMPS

DONALD R. JOHNSON [1]

Malaria eradication activities presently are being conducted in approximately 80 countries and territories of the world. This global program which is the most dramatic public health campaign in history, is being accomplished primarily through control of adult anopheline mosquitoes, utilizing DDT and other residual type insecticides applied inside the houses one to three times per year.

The following data prepared by the World Health Organization (Anon. 1960) summarize the present status of the worldwide malaria eradication program and indicate the magnitude of this tremendous operation (Table 1).

TABLE 1.—Status of malaria eradication, October 1960

World total population	2,872,377,000
Malaria free areas [2]	870,711,000
No data available	665,722,000
Original malarious areas	1,335,944,000
.....	
Malaria eradicated	298,012,000
With eradication program	612,623,000
With survey and pilot projects	169,928,000
No program started	255,381,000
Total (original malarious areas)	1,335,944,000

[2] Malaria was not indigenous in these areas or disappeared without specific anti-malaria measures being taken.

Since their inception, the malaria control, and later the malaria eradication programs, have been popular with literally hundreds of millions of persons in both hemispheres on both sides of the Equator (Fritz and Johnson). Governments have given high priority to continuation of the campaigns. The popularity of anti-malarial operations has been and is being reflected in the issuance of postage stamps depicting various aspects of these programs.[2a] The Mexican Government issued a blue one centavo stamp (Figure 1) in 1939 which was obligatory on all mail, the money raised through its sale being used to aid in malaria control activities (Harmer and Costales.) [3] The Mexican stamp which portrays a man on his knees with a monstrous mosquito on his back, symbolizes the heavy burden mankind has borne because of malaria. By coincidence, it was in Mexico in 1955, that the Eighth World Health Assembly passed a resolution calling for malaria eradication throughout the world. The Government of Mexico jointly with the Pan American Health Organization and the United Nations' Children's Fund (UNICEF) since that time has implemented one of the most outstanding malaria eradication programs in the world. The entire 35 million population of Mexico is now protected by the active malaria eradication program and insecticide spraying operations are being systematically withdrawn from formerly malarious areas when the danger of malaria transmission has passed.

In 1955, the Government of India issued a six anna stamp (Figure 2) as previously reported by Johnson. At that time the program in India, as in Mexico and most

[1] Entomologist and Assistant Chief, Malaria Eradication Branch, Office of Public Health, International Cooperation Administration, Washington, D. C.

[2a] I wish to acknowledge with thanks the assistance kindly given by John J. Hanlon, M.D. of Philadelphia, Pa., who provided me with certain information regarding stamps pertaining to malaria.

[3] The Government of Haiti in 1949 issued a series of six postage stamps, the price of which included a surtax for tuberculosis and malaria control operations. A T.B. sanatorium was pictured on these stamps, along with a mosquito. Haiti presently is organizing a nation-wide eradication program.

1

2

3

4

5

FIG. 1.—Mosquito attacking man. Mexico malaria control campaign stamp. 1939. FIG. 2.—Progress resulting from elimination of malaria. India malaria control stamp. 1955. FIG. 3.—Grassi, pioneer malaria research worker. Commemorative stamp issued by Government of Italy in 1955. FIG. 4.—"Destroy Malaria." Indonesia series of four malaria eradication stamps. 1960. FIG. 5.—Sprayman and anopheline mosquitoes. Iran malaria eradication stamps. 1960.

other countries with malaria, was one of malaria *control*. Since then, India, which has more than 400,000,000 persons living in areas originally malarious, has reorganized its program to one of *malaria eradication*. The International Cooperation Administration (ICA) of the United States Government has provided more than $50 million to the Government of India for malaria eradication since 1957 to make this possible. The World Health Organization (WHO) also has assisted by providing technical teams to study epidemiological problems. As indicated in Table 1, the great majority of the persons throughout the world living in originally malarious areas, including the tremendous population of India, now enjoy the protection afforded by this operation.

Italy was one of the more heavily malarious countries of the World prior to World War II. It subsequently was one of the first to eradicate this disease. Italy issued a green 25 lire stamp (Figure 3) in honor of Battista Grassi in 1955, the 30th anniversary of his death. It was Ronald Ross who first demonstrated transmission of a typical malaria parasite *(Plasmodium danilewskyi)* by a mosquito *(Culex fatigans)* from infected birds to healthy birds. However, it was Grassi, a perhaps somewhat lesser known contemporary of Ross, who was the first to verify completely the life cycle of the human parasites in anophelines (Boyd, 1949). It is appropriate that the Government of Italy issued this stamp depicting not only Grassi but also an anopheline mosquito and a microscope.

Two of the countries presently conducting active malaria eradication campaigns are Indonesia and Iran. Both issued colorful postage stamps during 1960 honoring the malaria eradication campaign.

Indonesia, with a population of more than 80,000,000 persons, most of whom are or have been exposed to malaria, is carrying out an ambitious program principally on the beautiful fertile islands of Java, Madura, Sumatra and Bali. President Sukarno issued a statement on February 16, 1961, to the effect that malaria eradication was one of the main principles included in the framework of the nation's development, namely to eliminate the obstacles hindering people in their daily work and to guarantee the health of every citizen. The program is expected to encompass the entire Indonesian Archipelago during the coming decade, with the combined cooperation of the Government of Indonesia, the ICA and the WHO.

The Indonesian series of four stamps is shown in Figure 4. A first day cover was issued on Indonesia's National Malaria Eradication Day, November 12, 1960. The denominations and colors are as follows:

25 sen [4]	violet
50 sen	brown
75 sen	green
3 Rupiahs [4]	orange

[4] 100 sen = 1 Rupiah (Rp.).

Each stamp depicts a side view of a female anopheline mosquito in the normal resting position. The Indonesian words "Basmilah malaria" translated are "Destroy malaria." The words "Hari Kesehatan Sedunia—1960" mean "World Health Day—1960."

Iran, previously known as Persia, is the land of the Persepolis, one of the Seven Wonders of the Ancient World. It is now participating in the malaria eradication program, a public health wonder of the modern world. Iran is being assisted in this nation-wide effort by WHO, UNICEF and ICA. Thirteen million Iranians live in areas originally known to be malarious which are now included in the program.

The Iranian stamps, recently depicted by Hyde, are shown in Figure 5. The denominations, colors, and themes are as follows:

1 Rial—Yellow background with red X lines, black mosquito (top view) and black lettering.
2 Rials—light blue background, dark blue sprayman, black lettering.
3 Rials—green background, red X lines, and side view anopheline mosquito resting on water surface.

Countries which previously have issued postage stamps with a malaria theme oriented toward the medical aspects of malaria are listed below:

1. Algeria. 1952 series of three stamps honoring pioneer malaria research workers who carried on studies in Algeria during the 19th Century:

   25 Francs, E. Millon, pharmacology of malaria therapy.
   40 Francs, Dr. F. Maillot, malaria treatment with quinine (1834).
   50 Francs, Dr. Alphonse Laveran, discovery of malaria parasites (1881).

2. Austria. 1957 commemorative 2.40 Schillings stamp honoring Dr. J. Wagner—Jauregg, who developed fever therapy for treatment of neurosyphilis utilizing induced malaria.

3. Portugal. 1958 series of two stamps, in denominations of 1.00 and 2.50 Escudos, commemorating the Sixth International Congress of Tropical Medicine and Malaria in Lisbon.

It is anticipated that there will be a number of additional postage stamps issued during the coming year utilizing the malaria eradication theme. The Executive Board of WHO (Anon. 1961) passed a resolution in October 1960 which states as follows:

"The Executive Board,

"Considering that postage stamps devoted to the world malaria eradication programme will be a valuable contribution to the dissemination of information on and will stimulate interest in the battle against malaria,

"1. Approves the plan for the issue of malaria eradication stamps;

"2. Invites Member States to arrange for issuing postage stamps devoted to the malaria eradication programme in accordance with this plan;

"3. Expresses its hope that Member States will find it possible to give the Organization either a percentage of the proceeds from the sale of such stamps, or quantities of stamps for sale to philatelists, or make other suitable donations;

"4. Invites the Universal Postal Union to co-operate with WHO in the implementation of the proposed plan and to extend any assistance it may consider possible and advisable;

"5. Requests the Director-General to take measures to ensure the successful carrying out of the proposed plan and to inform Member States of the arrangements made; and

"6. Requests the Director-General to inform the Fourteenth World Health Assembly of this plan to report on its development regularly to the Executive Board."

The plan referred to in 1. above, is the introduction of malaria eradication stamps by member countries of the Universal Postal Union on or about April 7, 1962, World Health Day. In February, 1961, the World Health Assembly, representing 109 countries or territories, passed a resolution expressing hope that such stamps will be issued. The theme is to be "World United Against Malaria."

Individuals and organizations interested in public health campaigns in general, or more specifically in malaria eradication and mosquito control, welcome the recent issuance of these Indonesian and Iranian postage stamps. It is hoped that many nations will follow the lead of Mexico, Italy, India, Indonesia, and Iran by similarly honoring the battle against mankind's most devastating vector-borne disease. The history of this program is being recorded philatelically. When future generations eventually are freed entirely of malaria and have forgotten its heavy toll, stamp collectors at least may be cognizant that their forebears suffered terribly from this disease and marshalled their forces to carry out the first global program organized to eradicate a disease.

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STUDIES OF RESISTANCE IN *AEDES TAENIORHYNCHUS*, CHATHAM COUNTY, GEORGIA

WILLIS MATHIS [1]

In 1957, studies were initiated in Chatham County, Georgia, to obtain susceptibility levels of *Aedes taeniorhynchus* to DDT and dieldrin. Although Chatham County has an extensive acreage of salt marsh from which large broods of *A. taeniorhynchus* periodically emerge, control measures prior to 1957 were limited to occasional adulticiding at Savannah and Savannah Beach. Since 1957, fogging operations with DDT have been county-wide in extent, but the larvicidal use of chlorinated hydrocarbon pesticides is not practiced.

All tests were conducted by using a resistance kit which employs papers commercially impregnated with DDT- or dieldrin-Risella oil solution (Mathis *et al.*, 1959). The test and holding chambers consist of plastic tubes 1–¾" x 5" fitted with a screen top and a removable metal shutter as a bottom. The test chambers are lined with impregnated papers, and mosquitoes are introduced for the desired exposure period. After exposure, the test specimens are transferred to holding tubes which are lined with untreated papers, offered food, and held for 24-hour mortality counts.

Most test specimens were obtained by collecting 3rd or 4th instar larvae, or pupae, from natural breeding places and completing the rearing in the laboratory. From Cockspur Island, additional specimens were obtained by flooding soil samples in the laboratory and rearing the larvae. Limited tests were also made with field-collected females from Cockspur, Tybee # 2, and the grounds of the Technical Development Laboratories.

The first tests were made during the summer of 1957 by exposing adult females collected from the laboratory grounds to DDT-Risella oil impregnated papers. A 60-minute exposure gave 89 percent mortality and 120-minute exposure gave 98 percent. During the winter of 1957–58, adults reared from flooded soil samples from Cockspur Island and exposed to the same residues gave a much lower mortality. When exposed to dieldrin residues the mortality was even less than that obtained with DDT. It was later discovered that the Georgia Department of Agriculture and the Plant Pest Control Division of the U. S. Department of Agriculture had treated approximately 134 acres on Cockspur Island during August 1957 with 4 to 5 pounds of dieldrin per acre for the control of the white-fringed beetle.

During 1958, tests were made with adults from Cockspur Island and from four other locations 1 to 7 miles from this island. Two of the locations were southeast of this island (1 to 2 miles) and

[1] From the Technical Development Laboratories, Technology Branch, Communicable Disease Center, Bureau of State Services, Public Health Service, U. S. Department of Health, Education, and Welfare, Savannah, Georgia.

two were northwest (5 to 7 miles). Table 1 gives the results obtained following exposures of female *A. taeniorhynchus* to Cockspur Island. Since two methods were used in obtaining adults for testing, the results obtained with females reared from

TABLE 1.—Mortalities obtained with exposure of female *Aedes taeniorhynchus* from Chatham County, Georgia, to commercially-impregnated, dieldrin-treated papers

Exposure, minutes	Percent conc.	Cockspur Island	Tybee # 1	Tybee # 2	Whitmarsh Island	Causton Bluff
60	0.2	..	0	7	0	0
"	0.4	5	0	12	9	3
"	0.8	1	22	78	33	35
"	1.6	18	95	100	93	97
120	0.2	..	..	..	..	0
"	0.4	8	..	..	..	23
"	0.8	36	..	100	..	79
"	1.6	33	..	100	..	99
240	0.2	..	..	..	..	..
"	0.4	57	..	..	..	..
"	0.8	51	..	100	..	..
"	1.6	26	..	100	..	..

Distance from Cockspur Island:
Tybee # 1—1 mile.
Tybee # 2—1.5 miles.
Whitmarsh—5 miles.
Causton Bluff—7 miles.

dieldrin-treated papers. A 60-minute exposure of females from Cockspur Island to 1.6 percent dieldrin papers gave only 18 percent mortality while a 240-minute exposure gave only 26 percent. This same dosage and a 60-minute exposure gave from 93 to 100 percent mortality of females from the four other locations. Although Tybee # 1 is approximately 1 mile from the nearest point on Cockspur Island, the mortality was essentially the same as that obtained from Causton Bluff, which is approximately 7 miles from Cockspur Island.

Using the same procedure and test specimens from the same locations, tests were made in which female mosquitoes were exposed to DDT-Risella oil impregnated papers. The results are shown in table 2. Exposure of females from Cockspur Island to 4.0 percent DDT papers for 60, 120, and 240 minutes gave 58, 35, and 63 percent mortality, respectively. A 60-minute exposure of females from the four other locations gave from 91 to 96 percent mortality.

Considerable variation in mortalities was obtained in tests with specimens from larvae or pupae collected in the field were compared with results obtained with adults reared from larvae obtained from soil samples brought into the laboratory and flooded. Table 3 gives the results with females obtained by the two different methods when exposed to DDT and to dieldrin.

Females from larvae reared in the field on Cockspur Island gave some response to an increase in exposure time to the 4.0 percent DDT papers but the highest mortality was only 53 percent with 240-minute exposure. With adults from flooded soil samples, the response to an increase in exposure time was similar to that obtained from adults from other locations. These data would tend to indicate that dieldrin selection of larvae in the field influenced susceptibility levels of the resultant adults to DDT.

When the same comparison was made with exposure to dieldrin, very little mortality was obtained with 60-, 120-, or 240-minute exposures to the 1.6 percent papers. With test specimens reared from soil samples from Cockspur Island, a mortality of approximately 50 percent was reached with

TABLE 2.—Mortalities obtained with exposure of female *Aedes taeniorhynchus* from Chatham County, Georgia, to commercially-impregnated, DDT-treated papers

Exposure, minutes	Percent conc.	Cockspur Island	Tybee # 1	Tybee # 2	Whitmarsh Island	Causton Bluff
60	0.5	..	..	14	17	6
"	1.0	35	..	21	50	25
"	2.0	42	..	78	84	54
"	4.0	58	91	96	94	93
120	0.5	..	..	7	..	14
"	1.0	27	..	46	..	28
"	2.0	63	..	93	..	70
"	4.0	35	..	98	..	100
240	0.5	..	..	24	..	..
"	1.0	74	..	66	..	..
"	2.0	76	..	98	..	..
"	4.0	63	..	99	..	..

TABLE 3.—Mortalities obtained with exposure to DDT and dieldrin of female *Aedes taeniorhynchus* from field-collected larvae and pupae and from egg-infested soil samples, Cockspur Island

	Field-collected larvae and pupae			Larvae from soil samples		
DDT concentration, %	1.0	2.0	4.0	1.0	2.0	4.0
Exposure-minutes						
60	2	2	8	51	32	73
120	3	3	18	42	95	92
240	0	12	53	90	93	93
Dieldrin concentrations, %	0.4	0.8	1.6	0.4	0.8	1.6
Exposure-minutes						
60	0	0	2	7	4	24
120	0	0	3	12	52	46
240	33	39	10	62	54	96

the 0.8 percent paper and 120-minute exposure, and, with the exception of the single replicate with the 1.6 percent paper at 240-minute exposure, the mortality remained essentially the same.

In limited tests with female *A. taeniorhynchus* collected from Tybee # 2 and exposed to 1.6 percent dieldrin papers, a 60-minute exposure gave 100 percent mortality. A 60- and 120-minute exposure of females from Cockspur to the same dieldrin papers gave 42 and 58 percent mortality, respectively. Females from the same location exposed for 60 and 120 minutes to 4.0 percent DDT papers gave 96 and 100 percent mortality of those from Tybee #2 and 5 and 51 percent of those from Cockspur.

ACKNOWLEDGMENT

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PRELIMINARY FIELD TESTS WITH THE RESIDUAL FUMIGANT TECHNIQUE[1]

WILLIS MATHIS AND DARRELL R. MADDOCK

Although the fumigant properties of several insecticides have been recognized and used for controlling insects (Tenhet *et al.*, 1957), the possibility of malaria control through such means apparently has been explored very little. However, recent investigations with malathion as a residual spray in plywood huts (Mathis and Schoof, 1959) indicated that this compound could kill mosquitoes through fumigant action, since the mosquitoes in the entrance cage without exposure to residues were also killed. Of greater significance was the discovery that commercial fly-bait containing DDVP and malathion readily killed mosquitoes through its fumigant action for periods up to 4 weeks (Mathis *et al.*, 1959). The potential of this residual fumigant technique for controlling anopheline vectors prompted further investigations of the technique.

Since the material used in the 1958 tests (Mathis *et al.*, 1959) was still effective when the tests were discontinued at the end of the mosquito season, these experiments were repeated in 1959. Four (8′ x 8′ x 7′) plywood huts, each with two open windows (3′ x 3′) on opposite sides, were used. Commercial fly-bait[2] (1.0 percent malathion, 0.5 percent DDVP) was placed in two huts. One or three 5-lb. bags were opened and placed in the center of each hut on the floor. In two huts, a formulation containing 10 percent technical DDVP (wt/wt) on an inorganic material (Perlite) was used. The quantity of DDVP/Perlite formulation in each hut gave an amount of DDVP equivalent to that contained in 1 or 3 bags of commercial fly-bait. Each of the four formulations was placed in a multiple wall bag (paper and polyethylene film) which originally contained commercial fly-bait. Caged adult female *A An. quadrimaculatus* (100 per cage) were placed in the same four positions in each hut about 3:30 p.m. and left overnight. Any survivors were held for an additional 24 hours and mortality determined. A fifth hut served for check purposes.

Other tests were conducted in plywood huts (11′ x 12′ with 6′ walls and a gable roof) with a volume of approximately 1000 cubic feet. Each hut had an eave opening (3″ wide) on two sides and a window (2′ x 2′) on four sides, all of which could be opened or closed as desired. To prevent excessive heat, a sprinkling system was installed on the roof. This system lowered the maximum indoor temperatures to approximately 85° F. With huts of the above type, preliminary tests were run to determine the effect of ventilation and vaporizer position on the effectiveness of the technique. DDVP vapor was obtained from 3″ x 6″ sealed polyethylene (0.004″ thick) bags, each of which contained 14 g. of purified DDVP on 5 g. of glass wool. These vaporizers were placed in huts at least one hour before the insects were introduced. Caged *A. quadrimaculatus* females were placed at 6 positions on the walls at elevations ranging from 1 to 10 feet above the floor. The mosquitoes were exposed for 4 hours, transferred to clean cages, fed, and held for 24-hour mortality.

Table 1 gives the mortality obtained from the DDVP-malathion fly-bait and DDVP-Perlite formulations. In the hut containing one 5-lb. bag of commercial fly-bait, mortalities of 89 to 100 percent were obtained for 7 weeks. With three

[1] From the Technical Development Laboratories, Technology Branch, Communicable Disease Center, Public Health Service, U. S. Department of Health, Education, and Welfare, Savannah, Georgia.

[2] Furnished through the courtesy of California Spray Chemical Company. Use of commercial materials or trade name does not constitute endorsement by the Public Health Service.

TABLE 1.—Results obtained with exposure of caged female *Anopheles quadrimaculatus* to DDVP or DDVP-malathion in ventilated huts for approximately 16 hours

Toxicant	Percent mortality at indicated weeks							
	3	4	6	7	8	9	10	12
1	100	100	35	3	..	..	..	..
2	100	100	100	100	24	5	..	..
3	100	91	100	89	55	5	..	..
4	100	100	100	100	100	100	85	59
5	2	1	8	6	2	5	0	1

[1] 11.4 g. of DDVP on Perlite (10 percent DDVP).
[2] 34.2 g. of DDVP on Perlite (10 percent DDVP).
[3] 5 lb. fly-bait (1.0 percent malathion, 0.5 percent DDVP).
[4] 15 lb. fly-bait (1.0 percent malathion, 0.5 percent DDVP).
[5] Check.

5-lb. bags, 100 percent mortality was obtained for 9 weeks; on week 10, the mortality was 85 percent, and by week 12, it was 59 percent. With the 10 percent DDVP-Perlite formulation, the mortality in the hut containing 11.4 g. of DDVP had dropped to 35 percent on week 6; but in the hut containing 34.2 g. of DDVP, 100 percent kill was obtained through week 7. Although no comparison could be made between the two formulations, the results indicated a similar response to an increase in dosage with each type and showed that DDVP alone produced extended fumigant action.

Tests made with the DDVP plastic bag vaporizers placed at ground level, or 6′ or 10′ above ground level, showed that a more uniform distribution of the vapor was obtained when the vaporizer was placed at the highest level.

The influence of different degrees of ventilation was studied in non-ventilated huts and huts having eaves and eaves-window ventilation. In a non-ventilated hut, one DDVP bag vaporizer gave complete mortality for 7 consecutive weeks.

With one vaporizer and eaves open, the mortality was lowered by as much as 50 percent. Under the same conditions, two vaporizers produced mortalities approaching 100 percent. With two diagonal windows open in addition to the eaves, it was necessary to use 3 bags of DDVP to produce approximately equivalent mortalities (Table 2).

In the non-ventilated hut, the vaporizer was removed after week 7; and the hut was opened to ventilation for three hours. After this ventilation, overnight exposure of caged mosquitoes in the non-ventilated hut resulted in complete mortality. A 4-hour exposure of caged mosquitoes 24 hours after removal of the vaporizer produced complete kills except at the top position (56%). After two additional days of ventilation, no mortality was obtained with a 4-hour exposure. These data suggest that the ventilation was insufficient to remove all of the vapor or that vapor-de-

TABLE 2.—Results obtained with exposure of caged female *Anopheles quadrimaculatus* to DDVP vapor in ventilated huts for 4 hours

No. of vaporizers	Percent mortality at vaporizer age in days							
	1	9	9[3]	10	14	15[3]	21	22
2[1]	91	100	99	57	98	100	86	91
3[2]	99	95	92	48	80	54	88	67

[1] Eaves open.
[2] Eaves and 2 windows open.
[3] Tests made from 7:00 to 11:00 p.m.

posited residues inside the hut continued to emit DDVP.

Table 3 gives results of tests similar to those reported in Table 2 except that a lower temperature prevailed at the end of the test period. During the first 9 days and at mean temperature of 74–78° F., high kills were obtained. However, on days 11, 12, and 13, mean temperatures were 70°, 67°, and 69° F., respectively; and the mortalities on day 13 were far below those obtained in the earlier tests. Although the DDVP vaporizer bag was 13 days old at this time, it is doubtful, in view of the data in Table 2, that age alone caused such a drastic reduction in mortality. Later tests with two new DDVP vaporizer bags also failed to give high mortalities. Therefore, temperature definitely appeared to be a factor influencing the effectiveness of this technique.

TABLE 3.—Influence of declining temperature on mortality of caged female *Anopheles quadrimaculatus* when exposed to DDVP vapor for 4-hour periods in September 1959

	Percent mortality at vaporizer age in days			
No. of vaporizers	1	2	9	13
2	100	100	99	9
3	76	100	91	17
Mean temp. (24-hr. period)	78	76	74	69

ACKNOWLEDGMENT

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OBSERVATIONS ON THE SNOW-WATER MOSQUITOES OF NEVADA

H. C. CHAPMAN

Entomology Research Division, Agric. Res. Serv., U.S.D.A.[1]

During mosquito surveys of agricultural areas in 1959 and 1960, many collections and observations were made in mountainous and foothill areas in Nevada. A group of mosquitoes of the subgenus *Ochlerotatus* Lynch-Arribalzaga inhabit these areas and are often called snow-water mosquitoes because they generally breed in water resulting directly or indirectly from snow melt. All species are univoltine and exhibit a preference for moderate to high elevations, depending on the latitude.

The paucity of information on these species in Nevada is evident when one considers that of the seven species involved, four were shown to be new State records. These four are *Aedes communis* (DeGeer), *A. hexodontus* Dyar, *A. pullatus* (Coq.), and *A. schizopinax* Dyar (Chapman, 1959).

Bohart (1950) reported nine species of snow-water *Aedes* from adjacent California, mentioned the taxonomic difficulties in separating certain of the adults, and discussed the differences of some larval characters that are usually described as being quite precise. *Aedes cinereus* Meigen is considered a snow-water mosquito in

[1] In cooperation with the Nevada Agricultural Experiment Station, Reno, Nevada.

California by Bohart. However, this species was never noted in Nevada in mountainous areas, only in foothill and valley areas where it was commonly associated with *A. idahoensis* (Theobald), *A. dorsalis* (Meigen), and *A. increpitus* Dyar. Both *A. idahoensis* and *A. dorsalis* are usually found in irrigated areas in the valleys. Thus, the writer does not consider *A. cinereus* to be a snow-water mosquito in the State. In this paper *A. schizopinax* is referred to as a snow-water mosquito for the following reasons: (1) It was observed many times at elevations up to 8,700 feet; (2) it was usually collected in water emanating from snow melt; and (3) it was found only in association with known species of snow-water mosquitoes. Collections by the writer in California indicate that *A. schizopinax* is also a snow-water mosquito there.

Ten species of snow-water mosquitoes are known from adjacent Utah (Nielsen & Rees, 1959).

Nevada snow-water *Aedes* breeding was observed from early March to July at elevations ranging from 4,300 to 10,000 feet. The seasonal occurrence differed with the altitude, breeding site, temperature, amount of snow pack, and the hatching threshold temperature of the egg. The different ecological, biological, and taxonomic data presented herein were obtained by the writer unless otherwise indicated.

Aedes cataphylla DYAR

The writer collected larvae several times in the Sierra Nevada Mountains near Lake Tahoe in open meadow pools at elevations ranging from 6,400 to 7,000 feet. Associated species were *Aedes hexodontus, A increpitus,* and *A. fitchii* (Felt and Young). When in the company of these species, *A. cataphylla* larvae were generally an instar ahead in development. Biting adults were noted in the Sierra Nevada Mountains and in eastern Nevada in the Virgin Mountains and the Toiyabe Range.

A. cataphylla is the only species on which the siphonal tuft of the larvae is located within the pecten. The females are easily separated from other black-legged *Aedes* because they have scattered pale scales on the costa, subcosta, and radial veins of the wing.

Richards *et al.* (1956) reported *A. cataphylla* from Eureka County.

Collection Data:

CLARK COUNTY: Bunkerville, female, IV–15–59 (R. C. Bechtel).

DOUGLAS COUNTY: Spooner Summit, larvae, III–27–59; larvae, IV–7–60, 7,000 feet; Glenbrook, larvae, IV–18–60, 6,400 feet; Lake Tahoe, larvae, IV–20–60, 6,700 feet.

LANDER COUNTY: Kingston Canyon, females, IV–21–59, 6,300 feet (R. C. Bechtel).

WASHOE COUNTY: Mt. Rose, females, VIII–24–58, 8,200 feet.

Aedes communis (DEGEER)

Abundant larval populations were observed in the Sierra Nevada Mountains from 5,800 to 7,800 feet and in the Ruby Mountains in eastern Nevada from May to June at elevations from 7,200 to 8,700 feet. Habitats were open and shaded areas, especially overflow meadow pools adjacent to streams, meadow pools, and old stream beds. Associated species were *A. hexodontus, A. increpitus,* and *A. pullatus,* and when in the same pools with these species, *A. communis* larvae quite often pupated about 2 to 3 weeks sooner. In the Sierras, biting adults were common in June in shaded pine and aspen woods at elevations of 6,300 to 8,200 feet, whereas in the Ruby Mountains they were extremely abundant later in June at elevations of 8,800 to 9,500 feet and constituted a problem in that recreational area.

The larvae are easily confused with those of *A. increpitus,* but *A. communis* larvae possess speckled anal gills, have a shorter siphon, and lack large spicules on the apex of the saddle. Double upper or lower frontal head hairs are not uncommon; thus this character should not be used in separating *A. communis* from *A. increpitus.* Adults of *A. communis* possess black supraalar bristles and mixed black yellow forked hairs on the vertex

which differentiate it from *A. hexodontus*.

Collection Data:

DOUGLAS COUNTY: Spooner Summit, larvae, III–19–59; larvae, IV–7–60, 7,100 feet; Glenbrook, larvae, IV–24–59; larvae, III–22–60; females, VI–8–60, 6,300 feet.

ORMSBY COUNTY: Lake Tahoe, larvae, IV–18–60, 6,500 feet; Marlette Lake, larvae, VI–8–60, 7,600 feet.

WASHOE COUNTY: Lake Tahoe, larvae, IV–9–59; larvae, IV–18–60, 6,300 feet; Mt. Rose, larvae, IV–21–59, 7,800 feet, female, VI–18–60, 8,100 feet; Sundown, larvae, IV–18–60, 5,800 feet.

ELKO COUNTY: Lamoille Canyon, larvae, VI–2–59, 7,200 to 8,700 feet; larvae, V–26–60, 7,200 to 8,500 feet; females, VI–22–60, 8,000 to 9,500 feet

Aedes fitchii (FELT AND YOUNG)

Large larval populations were noted from April to June in the Sierra Nevada Mountains in open meadow pools and ponds and open marshy lake margins at elevations ranging from 6,800 to 8,700 feet. Collections were also made in shaded meadow pools and roadside ditches in the foothills of the Ruby Mountains (5,500 to 6,000 feet). *Aedes hexodontus, A. increpitus,* and *A. schizopinax* were associated species. In any given pool with one or more of these species, *A. fitchii* larvae were usually the last to mature. Biting adults were noted in partially shaded woods in June and July.

The long slender siphon is distinctive only to *A. fitchii* larvae, whereas the abundantly scattered, pale scales on the wings can be used to separate adults from *A. increpitus*. *A. fitchii* adults also usually possess a T-shaped patch of pale scales on the dorsal aspect of the first abdominal segment.

Richards *et al.* (1956) reported *A. fitchii* from Eureka and Humboldt Counties.

Collection data:

ELKO COUNTY: Lamoille, larvae, V–26–60; Jiggs, larvae, V–26–60; Deeth, larvae, V–27–60; Wilkins, females, VI–23–60.

DOUGLAS COUNTY: Spooner Summit, larvae, III 19–59; larvae, IV–7–60, 7,100 feet; Lake Tahoe, larvae, III–29–59; larvae, IV–20–60, 6,700 feet; Glenbrook, larvae, IV–24–59; larvae, IV–18060, 6,400 feet.

WASHOE COUNTY: Hunter Lake, larvae, VI–12–59, 8,700 feet; females, VII–23–59, 8,500 feet.

Aedes hexodontus DYAR

Larval collections of *A. hexodontus* were made in both the Sierra Nevada and Ruby Mountains at elevations ranging from 6,300 to 10,000 feet. Although the larvae were often found alone at higher elevations, they were also collected in association with all of the other snow-water *Aedes*. Breeding was mostly noted in open and partially shaded meadow pools, ponds, and marshy lake margins from March to June. Biting adults were observed in June and July. *A. hexodontus* is undoubtedly the most important pest species in many mountain areas.

The complete encircling of the anal segment by the saddle is diagnostic in separating larvae of this species from the other snow-water *Aedes*. The upper and lower frontal head hairs are usually double and the average number of comb scales is 5–6, although the writer observed some larvae with 11 to 13. These specimens would bypass *A. hexodontus* in most keys since the number of comb scales is usually given as 9 or less. The mesonotal hair 1 is generally single and of medium length instead of short and multiple as depicted in Carpenter and LaCasse (1955) and Yamaguti and LaCasse (1951). Adults have supra-alar bristles and upright forked vertex scales that are straw-colored.

Collection Data:

DOUGLAS COUNTY: Spooner Summit, larvae, III–19–59; larvae, IV–7–60, 6,700 feet; Glenbrook, larvae, IV–24–59; larvae, IV–18–60, 6,300 feet; Stateline, larvae, III–29–60, 6,400 feet.

ELKO COUNTY: Lamoille Canyon, larvae, VI–2–59; larvae, V–26–60, 8,000 to 8,700 feet; larvae, VI–22–60, 8,500 to 10,000 feet.

ORMSBY COUNTY: Lake Tahoe, larvae, III–16–59, 6,300 feet; larvae, IV–7–60, 6,700 feet; Marlette Lake, larvae, VI–8–60, 7,600 feet.

Washoe County: Mt. Rose, larvae, IV–21–59, 7,800 to 8,000 feet; larvae, V–25–59, 7,500 to 8,700 feet; larvae, VI–30–59, 9,500 feet; larvae, V–20–60, 7,500 to 8,700 feet; females VI–13–60, 7,800 feet; Hunter Lake, larvae, females, VI–11–59, 8,200 to 8,700 feet; females, VII–23–59, 8,200 feet; Marlette Lake, larvae, VI–8–60, 8,000 feet.

Aedes increpitus Dyar

Larval populations of this species were observed from March to June in the Sierra Nevada and the Ruby Mountains at elevations ranging from 4,300 to 8,200 feet. Habitats were open and shaded meadow pools and ponds in the mountains and open and shaded pond and pool margins and open roadside ditches in the lower foothills. *A. increpitus* was the most common snow-water mosquito noted at lower elevations in the foothills and valleys. Although *A. increpitus* was observed associating with all of the other snow-water *Aedes* species except *A. cataphylla,* it was most often found with *A. communis* and *A. hexodontus.* In the same pool development was usually an instar or two behind these species. Biting adults were collected from June to August. *A. increpitus* is one of the principal biting pests in the foothills and resort areas at higher elevations.

The large spicules on the apex of the anal saddle and the creamy white, almost transparent anal gills of the larvae separate *A. increpitus* from *A. communis.* The second character appears to be specific to *A. increpitus* larvae since the anal gills of other snow-water *Aedes* are speckled or spotted. Females resemble *A. fitchii* but have a few or no pale scales on the inner surface of the torus, whereas the inner surface of the torus of *A. fitchii* has a conspicuous patch of pale scales. *A. increpitus* females are much neater and less shaggy looking than *A. fitchii* since they have the pale scales concentrated toward the costal margin of the wings.

Richards *et al.* (1956) reported the species from Eureka County.

Collection Data:

Douglas County: Lake Tahoe, larvae, III–4–59, 6,300 feet; Glenbrook, larvae, IV–9–59; larvae, III–22–60; larvae, females, males, VI–6–60, 6,300 feet; Gardnerville, larvae, IV–26–59, 5,900 feet; Stateline, larvae, III–29–60, 6,600 feet.

Elko County: Lamoille Canyon, larvae, VI–2–59, 7,500 feet; larvae, V–26–60, 7,200 feet; Lamoille, V–5–60; Ruby Lake, larvae, V–4–60; Deeth, larvae, V–27–60; Jiggs, larvae, V–26–60.

Lyon County: Dayton, females, VII–15–58, larvae, III–20–59; larvae, IV–7–59; larvae, III–7–60, 4,500 feet.

Ormsby County: Marlette Lake, larvae, VI–8–60, 7,600 feet; Lake Tahoe, larvae, III–4–59, 6,300 feet; larvae, IV–18–60, 6,500 feet;

Storey County: Virginia City (Six-Mile Canyon), larvae, III–18–60, 4,700 feet.

Washoe County: Washoe Valley, larvae, III–19–59, 4,300 feet; Lake Tahoe, larvae, IV–9–59; larvae, IV–18–60, 6,300 feet; Mt. Rose, larvae, IV–21–59, 7,500 feet; females, VIII–26–58, 7,500 feet; females VI–18–60, 8,100 feet; Hunter Lake, larvae, VI–21–59, 8,200 feet.

Aedes pullatus (Coq.)

Abundant larval populations of *A. pullatus* were observed only in the Ruby Mountains from May to June at elevations ranging from 7,200 to 10,000 feet. Habitats were both open and shaded meadow pools, usually adjacent to streams, which they shared with *A. hexodontus, A. increpitus,* and *A. communis.* When in the company of the first two species, *A. pullatus* was usually the first to emerge. It is one of the principal pest species in this outdoor mecca. Biting females were observed in June.

The dark head, multiple upper and lower frontal head hairs, and comb scales with subequal spinules separate *A. pullatus* from larvae of other snow-water *Aedes.* The thoracic pattern and possession of a hypostigial spot of scales delimits the females from other black-legged snow-water *Aedes.*

Collection Data:

Elko County: Lamoille Canyon, larvae, VI–2–59, 7,200 to 8,700 feet; larvae, V–5–60; larvae, V–26–60, 7,200 to 8,300

feet; females, larvae, VI–22–60, 8,000 to 8,800 feet; larvae, VI–22–60, 10,000 feet.

Aedes schizopinax DYAR

Larvae of *A. schizopinax* were collected from the Sierra Nevada Mountains and in eastern Nevada from the Schell Creek and Toiyabe Ranges and the foothills of the Ruby Mountains. Habitats were usually open meadow pools and marshy lake margins at elevations ranging from 5,000 to 8,700 feet. Since the species occurs at these elevations, generally in water resulting from snow melt and in the company of such other snow-water *Aedes* as *A. hexodontus, A. increpitus,* and *A. fitchii,* it should be referred to as a snow-water mosquito. Nothing is known of the habits of the adults. *A. schizopinax* may not be an important pest since no adult activity was observed during several visits to areas where considerable numbers of larvae had been produced.

The large many-branched mesothoracic hair 1 and the long lateral hair of the anal segment separate *A. schizopinax* from its larval congeners. In larvae in the western parts of the State (Sierra Nevada Mountains) the upper and lower frontal head hairs are usually four- and three-branched, respectively, whereas in larvae from the eastern areas these two head hairs are usually three- and two-branched. The yellow or grey scaling of the ventral aspect of the proboscis and the usual dorsal pale scaling of the entire last abdominal segment separate it from other black-legged snow-water *Aedes*.

Collection Data:

DOUGLAS COUNTY: Genoa, larvae, II–25–60, 5,000 feet.

ELKO COUNTY: Ruby Lake, larvae, V–4–60; larvae, V–26–60, 5,100 feet.

LANDER COUNTY: Kingston Canyon, larvae, V–3–60, 7,000 feet.

WASHOE COUNTY: Mt. Rose (Thomas Creek Canyon), larvae, IV–21–59; larvae, IV–11–60, 6,000 feet; Hunter Lake, larvae, VI–11–59, 8,200 to 8,700 feet.

WHITE PINE COUNTY: Ely, larvae, V–3–60, 6,000 feet.

SUMMARY. Snow-water mosquito breeding was observed from early March to July at elevations ranging from 4,300 to 10,000 feet. Seven species, *Aedes cataphylla, A. communis, A. fitchii, A. hexodontus, A. increpitus, A. pullatus,* and *A. schizopinax* are reported as snow-water mosquitoes in the State. The latter species is designated as a snow-water mosquito in Nevada and California for the first time owing to its breeding habitat and association only with other known snow-water mosquito species.

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MOSQUITO INTERCEPTIONS AND RELATED PROBLEMS IN AERIAL TRAFFIC ARRIVING IN THE UNITED STATES

JOHN H. HUGHES [1]

The problem of preventing importation of live mosquitoes and other medically important arthropods into the United States was relatively simple 30 years ago. At that time, approximately 5,000 aircraft were arriving annually in Public Health Service quarantine. The aircraft in use then were rather small and often flew from countries no more distant than the Americas. Most of them could be met at the time of arrival, inspected, and treated to eliminate any live mosquitoes.

Beginning in 1943 the annual rate of foreign flights increased rapidly. Aircraft arriving in Public Health quarantine totaled 36,322 in 1945, increased to 54,759 in 1955, and reached 70,383 in 1960. As the number of flights increased, the size and speed of aircraft and the distance covered in non-stop flights kept pace, thus adding to the complexity of the insect control problem. It is not unusual for an aircraft en route from Africa, South America, or elsewhere in the world to arrive at one of our ports in the South, in Puerto Rico, or in Honolulu in a matter of a few hours, thus bringing us very close to important arthropod vectors of other parts of the world and to the diseases they transmit. The protective barrier of time and distance provided by the earlier, slower aerial traffic has been removed and mosquitoes and other insects may now arrive alive from virtually all parts of the world.

Another of the growing problems facing those responsible for the control of insects transported accidentally in aircraft is that of insecticide resistance. Numerous species of medically important insects have exhibited varying and sometimes alarming degrees of such resistance. A list prepared by the World Health Organization (1) in late 1960 shows that the insects known to be resistant to chlorinated hydrocarbons ordinarily employed in malaria eradication programs include 30 species of anopheline mosquitoes, many of importance as malaria transmitters. At least four of these (*A. albimanus, A. pseudopunctipennis, A. punctimacula,* and *A. quadrimaculatus*) have been intercepted on aircraft arriving in the United States during the past few years.

PROTECTIVE MEASURES. The Public Health Service quarantine entomology program is directed against the hazard of introduction and establishment of insects, particularly vectors of diseases affecting man. Professional entomologists and supporting staff are maintained in principal locations where the threat of insect importation is considered greatest. Quarantine stations apply insect control measures in aircraft upon arrival from foreign countries as required by quarantine regulations authorized by the Public Health Service Act. The entomology program involving aerial traffic includes aircraft disinfestation and entomological surveillance of airports. This is supplemented with *Aedes aegypti* control activities in many of the international traffic points in the yellow-fever receptive area of the South, Puerto Rico, and the Virgin Islands (2).

In general, aircraft arriving in the United States from foreign countries located in the area bounded on the north by 45 degrees north latitude and on the south by 45 degrees south latitude are subject to disinfestation measures. Planes arriving in this country at points south of the 35th parallel are subject to disinfestation on a year-round basis. Aircraft arriving north of the 35th parallel are subject to disinfestation only during the period April

[1] Scientist Director, Division of Foreign Quarantine, Public Health Service, U. S. Department of Health, Education, and Welfare, Washington, D. C.

through September, except under special circumstances which may arise.

Approximately 50 percent of all arriving aircraft are considered of significance to the entomology program and are inspected for presence of insects. Results of these on-arrival inspections will be mentioned later in this paper.

AIRCRAFT DISINFESTATION. Insecticidal aerosols formulated for use in aircraft disinfestation are employed. Four formulations, known as G-382, G-651, G-1152, and G-1029, each containing pyrethrins and DDT, are authorized by the Public Health Service (3) and the World Health Organization (4) for use on aircraft in international traffic. A minimum application of five grams of these insecticidal aerosols is recommended by the Public Health Service for each 1,000 cubic feet of enclosed aircraft space to be treated. The World Health Organization currently recommends a minimum of 10 grams for each 1,000 cubic feet of enclosed space. Also, that Organization insists on application of the insecticide prior to departure of aircraft from an airport, while the United States and other countries provide for disinfestation of aircraft while in flight if not accomplished prior to takeoff. However, we are now studying the feasibility of using the predeparture application of an insecticide on aircraft leaving this country. Such application should give greater protection against insects that are transported by aircraft. It would (1) permit the use of a single, large application of insecticide which could be employed in the absence of passengers and crew; this, perhaps, would meet both public health and agricultural requirements; it would (2) immobilize insects at the beginning of a flight and provide a longer interval during which the slow-acting DDT or other insecticides could take effect; and (3), when applied to aircraft departing for the United States, would eliminate the need for the on-arrival disinfestation now applied to more than 15,000 aircraft arriving each year. This method could be employed only with the full cooperation of health departments of other countries to protect the United States against an influx of live insects.

The predeparture disinfestation concept is not new. The United States for many years has been an advocate of predeparture spraying of aircraft, provided proper conditions prevail. As early as 1939 the Service established and operated an experimental aircraft disinfestation base at Trinidad, B.W.I., with an inspection station at San Juan, P. R. (5). This work was expanded and continued until 1941 when the quarantine inspectors were recalled and the responsibility was transferred to the airlines where it soon met with abandonment in favor of in-flight application. Since 1941 the Service has applied predeparture measures in a few instances when requested by other countries.

Methods other than the use of insecticidal aerosols are being considered for use in international air traffic. These include vaporization of insecticides and the use of single-dose aerosol dispensers of a semi-automatic nature.

ENTOMOLOGICAL FINDINGS. Thousands of insects, nearly all in the adult stage, are found on aircraft arriving at our ports from foreign countries each year. An earlier report by the writer (6) covered entomological records for aircraft arriving in the United States during the 10-year [2] period ending June 30, 1947. The present paper is for the 13-year period ending June 30, 1960, and is concerned primarily with mosquitoes. The records are from quarantine stations located at Brownsville and Houston, Texas; Honolulu, Hawaii; Miami, Florida; New Orleans, Louisiana; New York, New York; and San Juan, Puerto Rico. These seven localities receive most of the international flights arriving in this country.

During the 13-year period beginning July 1, 1947, and ending June 30, 1960, nearly a quarter of a million insects were recovered from aircraft. This number is shown in Table 1 which includes other

[2] Fiscal year, which is 12-month period ending June 30, employed throughout paper.

TABLE 1.—Aircraft disinfestation data, July 1, 1948–June 30, 1960 [1]

Fiscal year	Number of aircraft			Entomological findings							
		Harboring		All Insects				Mosquitoes			
	Inspected	All insects	Mosquitoes	K-d	Alive	Dead	Total	K-d	Alive	Dead	Total
1960	37,248	8,394	1,609	3,007	3,213	25,435	31,655	359	197	5,896	6,452
1959	37,245	7,591	959	4,872	3,849	19,555	28,276	269	326	1,220	1,815
1958	31,192	6,346	785	3,598	2,832	16,919	23,349	138	257	1,093	1,488
1957	30,145	4,467	728	2,325	2,712	9,878	14,915	113	333	1,403	1,849
1956	28,250	4,879	829	3,028	3,505	9,849	16,382	154	522	1,421	2,097
1955	31,412	4,209	474	3,123	2,973	6,602	12,698	81	221	471	773
1954	28,563	4,601	388	3,449	3,129	7,797	14,375	59	124	414	597
1953	20,407	3,645	299	2,521	2,625	6,719	11,865	62	75	358	495
1952	23,677	5,283	358	5,869	2,445	12,215	20,529	48	45	406	499
1951	22,668	4,030	496	3,450	3,035	13,470	19,955	200	73	606	879
1950	23,421	4,772	670	2,225	4,036	13,724	19,985	155	83	1,202	1,440
1949	23,531	4,053	695	1,135	1,898	11,374	14,407	86	85	1,044	1,215
1948	21,751	4,445	629	973	1,136	18,772	20,881	25	127	941	1,093
Total	359,516	66,715	8,919	39,575	37,388	172,309	249,272	1,749	2,468	16,475	20,692

[1] Brownsville, Honolulu, Houston, Miami, New Orleans, New York, and San Juan (except Honolulu not included in 1948, 1949, and 1950.

TABLE 2.—Mosquitoes found in aircraft[1] during the 13-year period ending June 30, 1960

Mosquito species	Condition when found			Total
	Knock-down	Alive	Dead	
Aedeomyia catasticta Knab	0	0	1	1
Aedeomyia squamipennis (L.-A.)	0	1	9	10
Aedes aegypti (L.)	1	8	9	18
Aedes albifasciatus (Macq.)	1	0	137	138
Aedes albopictus (Skuse)	0	0	1	1
Aedes atlanticus D. and K.	0	0	1	1
Aedes cantator (Coq.)	0	0	1	1
Aedes condolescens D. and K.	0	0	1	1
Aedes dorsalis (Meig.)	0	0	7	7
Aedes euiris Dyar	1	0	17	18
Aedes euplocamus D. and K.	0	0	2	2
Aedes fulvithorax (Lutz)	0	0	2	2
Aedes lineatopennis (Lud.)	0	0	7	7
Aedes mediovittatus (Coq.)	1	0	2	3
Aedes mitchellae (Dyar)	0	0	3	3
Aedes nigromaculis (Lud.)	1	0	0	1
Aedes obturbator D. and K.	0	0	1	1
Aedes pampangensis (Lud.)	0	0	1	1
Aedes polynesiensis Marks	0	0	3	3
Aedes scapularis (Rond.)	0	1	4	5
Aedes serratus (Theob.)	0	0	1	1
Aedes sollicitans (Walk.)	12	12	256	280
Aedes species	12	25	1,526	1,563
Aedes sticticus (Meig.)	0	0	1	1
Aedes taeniorhynchus (Wied.)	338	204	4,474	5,016
Aedes thelcter Dyar	0	2	5	7
Aedes tortilis (Theob.)	0	3	13	16
Aedes vexans (Meig.)	0	1	25	26
Aedes vexans nipponii (Theob.)	0	0	2	2
Aedes vexans nocturnus (Theob.)	0	0	16	16
Aedes vigilax (Skuse)	0	0	3	3
Anopheles albimanus Wied.	25	69	144	238
Anopheles albitarsis L.-A.	0	0	23	23
Anopheles annularis V.d.W.	0	0	3	3
Anopheles annulipes Walk.	0	0	1	1
Anopheles atropos D. and K.	0	1	4	5
Anopheles barbirostris V.d.W.	0	0	2	2
Anopheles crucians Wied.	17	5	145	167
Anopheles grabhamii Theob.	0	1	30	31
Anopheles litoralis King	0	0	4	4
Anopheles neomaculipalpus Curry	0	1	5	6
Anopheles nigerrimus Giles	0	0	4	4
Anopheles pseudopunctipennis Theob.	0	0	9	9
Anopheles punctimacula D. and K.	0	0	3	3
Anopheles punctipennis (Say)	0	0	1	1
Anopheles quadrimaculatus Say	10	6	140	156
Anopheles sinensis Wied.	0	0	3	3
Anopheles species	4	7	262	273
Anopheles subpictus Grassi	0	0	2	2
An. subpictus indefinitus (Lud.)	0	0	40	40
Anopheles vestitipennis D. and K.	0	3	7	10
Anopheles walkeri Theob.	6	0	5	11
Culex americanus (N.-L.)	0	0	3	3
Culex annulirostris Skuse	0	0	22	22
Culex bahamensis D. and K.	2	0	21	23

[1] Which arrived at Brownsville, Honolulu, Houston, Miami, New Orleans, New York and San Juan (except Honolulu not included in 1948, 1949, and 1950).

TABLE 2.—(Continued)

Mosquito species	Condition when found			
	Knock-down	Alive	Dead	Total
Culex coronator D. and K.	0	0	1	1
Culex duplicator D. and K.	0	0	1	1
Culex erraticus (D. and K.)	0	0	4	4
Culex fuscocephalus Theob.	0	0	4	4
Culex habilitator D. and K.	0	0	58	58
Culex interrogator D. and K.	0	0	1	1
Culex nigripalpus Theob.	13	30	129	172
Culex peus Speiser	1	4	18	23
Culex pilosus (D. and K.)	0	0	2	2
Culex pipiens L.	1	2	47	50
Culex quinquefasciatus Say	754	1,362	2,680	4,796
Culex salinarius Coq.	38	9	245	292
Culex sitiens Wied.	0	0	8	8
Culex species	354	434	2,911	3,699
Culex tarsalis Coq.	21	61	257	339
Culex tritaeniorhynchus Giles	0	0	6	6
Culex univittatus Theob.	0	0	1	1
Culex whitmorei (Giles)	0	0	65	65
Culiseta annulata (Schrank)	0	0	1	1
Culiseta inornata (Will.)	1	3	13	17
Culiseta particeps (Adams)	0	0	1	1
Culiseta species	8	5	25	38
Deinocerites cancer Theob.	2	0	35	37
Mansonia crassipes (V.d.W.)	0	0	1	1
Mansonia dives (Schiner)	0	0	2	2
Mansonia flaveola (Coq.)	1	0	9	10
Mansonia humeralis D. and K.	2	0	10	12
Mansonia indubitans D. and S.	3	9	168	180
Mansonia perturbans (Walk.)	4	1	26	31
Mansonia pseudotitillans (Theob.)	0	0	1	1
Mansonia species	16	7	347	370
Mansonia titillans (Walk.)	20	47	295	362
Mansonia uniformis (Theob.)	0	0	10	10
Orthopodomyia signifera (Coq.)	0	0	1	1
Psorophora ciliata (Fab.)	7	4	42	53
Psorophora confinnis (L.-A.)	51	93	741	885
Psorophora cyanescens (Coq.)	3	12	28	43
Psorophora discolor (Coq.)	2	4	11	17
Psorophora pygmaea (Theob.)	0	0	37	37
Psorophora species	2	3	169	174
Uranotaenia lowii Theob.	0	1	19	20
Uranotaenia sapphirina (O.S.)	0	0	8	8
Wyeomyia species	0	4	0	4
Culicidae species	14	23	623	660
Total	1,749	2,468	16,475	20,692

data relating to aircraft treatment as accomplished on an annual basis. Of this number, 15.9 percent were knocked down (alive, but inactive), 15.0 percent were alive (active), and 69.1 percent were dead. Although not shown in the table, the yearly average of all insects intercepted at the seven points mentioned was 19,175.

Because of heavy aircraft schedules and sometimes lack of adequate personnel, it is often possible to make only a rapid inspection of an aircraft following the on-arrival insecticide application. Even then, the results are interesting, particularly with reference to mosquitoes. For example, 20,692 mosquitoes (2,468 alive, 1,749

knocked down, and 16,475 dead) were intercepted during the 13-year period, as may be noted in Table 1. This large number is also shown in Table 2 which lists all of the mosquitoes by species, viable condition when found, and number. The family Culicidae is represented here by 11 genera and 92 species. The important malaria-transmitting genus *Anopheles* alone comprises 20 species, or 21.7 percent of all species found. This is surpassed only by *Aedes* which comprises 28 of the total species. The work of Stone, *et al.* (7) was used as a basis in arriving at the taxonomic listings in this paper, except for *C. quinquefasciatus* which is considered as a species.

More than 80 percent (80.8) of the mosquitoes intercepted during the 13-year period belong in two genera, *Aedes,* (34.5 percent) and *Culex* (46.3 percent). *Aedes taeniorhynchus* alone was represented by 5,016 specimens and comprised 70.2 percent of all the *Aedes* and 24.2 percent of all the mosquitoes. *Culex quinquefasciatus* likewise consisted of a large number of specimens. The two species collectively consisted of 9,812 specimens or 47.4 percent of all mosquitoes found.

Fifty-one species of mosquitoes shown in Table 2 are not known by the writer to be present in nature in one or more of the general areas (Continental United States, Hawaii, and Puerto Rico) where they were intercepted on aircraft during the 13-year period considered. The finding of these mosquitoes is proof that they are being transported to this country, sometimes from distant airports. The areas of interception of these 51 non-indigenous species are shown in Table 3. Twenty-nine of these species apparently are new to our aircraft interception records for the areas considered. The remaining 22 species of Table 3 were also reported in an earlier paper (6).

Twenty of the species shown in Table 3, intercepted at ports in Continental United States, do not occur in this country. Of these 20 species, *Anopheles grabhamii, Anopheles neomaculipalpus,* and *Anopheles vestitipennis* were represented by specimens which were alive when found on aircraft. Five species included specimens in a knocked-down condition when first observed.

Honolulu interceptions included 31 species of mosquitoes non-indigenous to the Islands of Hawaii. Noteworthy among this array are eight species of anophelines. Although all but one of the specimens were dead when the aircraft were inspected upon arrival at Honolulu, the real hazard of introduction of some of these species is apparent. In view of the semi-tropical climate in Hawaii and the presence of only three species established in nature there, it is important that mosquito control measures be applied effectively on aircraft entering that State.

Records indicate that Puerto Rico was more fortunate than Continental United States and Hawaii with respect to receiving non-indigenous mosquitoes in aerial traffic. Only two such species were recorded for aircraft arriving in San Juan during the 13-year period.

Thirty-seven of the species listed in Table 3 (each preceded by an asterisk) apparently have not been reported as being found under natural conditions in Continental United States, Hawaii, and Puerto Rico.

In addition to the non-indigenous mosquito species it is not uncommon to find other species of Culicidae on aircraft arriving at various airports in the United States where they are not known to occur in nature, although they may be present in other parts of the country. Some species transported from other countries to our airports are not actually considered as being imported since the species also occur in the airport area where the aircraft interceptions are made.

The interception of the large number of non-indigenous species mentioned leaves little doubt as to the value of quarantine measures against the importation of insects. The escape and establishment of any one of the more important malaria

TABLE 3.—Mosquitoes intercepted on aircraft which arrived in areas where the species are not known to occur, July 1, 1948–June 30, 1960

Mosquito species	Place and number of specimens intercepted			
	Continental United States	Hawaii	Puerto Rico	All stations
n*_Aedeomyia catasticta_ Knab	..	1	..	1
*_Aedeomyia squamipennis_ (L.-A.)	10	..	..	10
*_Aedes albifasciatus_ (Macq.)	132	..	..	132
n _Aedes condolescens_ D. and K.	1	..	..	1
Aedes dorsalis (Meig.)	..	6	..	6
n*_Aedes euiris_ Dyar	18	..	..	18
n*_Aedes euplocamus_ D. and K.	2	..	..	2
*_Aedes fulvithorax_ (Lutz)	2	..	..	2
*_Aedes lineatopennis_ (Lud.)	..	7	..	7
n*_Aedes mediovittatus_ (Coq.)	2	..	1	3
n _Aedes obturbator_ D. and K.	1	..	..	1
n*_Aedes pampangensis_ (Lud.)	..	1	..	1
n*_Aedes polynesiensis_ Marks	..	3	..	3
n _Aedes serratus_ (Theob.)	1	..	..	1
n _Aedes sticticus_ (Meig.)	..	1	..	1
Aedes taeniorhynchus (Weid.)	..	27	..	27
Aedes vexans (Meg.)	..	13	..	13
n*_Aedes vexans nipponii_ (Theob.)	..	2	..	2
n*_Aedes vexans nocturnus_ (Theob.)	..	16	..	16
*_Aedes vigilax_ (Skuse)	..	3	..	3
*_Anopheles albitarsis_ L.-A.	23	..	..	23
n*_Anopheles annularis_ V.d.W.	..	3	..	3
n*_Anopheles annulipes_ Walk.	..	1	..	1
n*_Anopheles barbirostris_ V.d.W.	..	2	..	2
Anopheles grabhamii Theob.	28	..	..	28
*_Anopheles litoralis_ King	..	4	..	4
*_Anopheles neomaculipalpus_ Curry	6	..	..	6
*_Anopheles nigerrimus_ Giles	..	4	..	4
n*_Anopheles punctimacula_ D. and K.	3	..	..	3
n*_Anopheles sinensis_ Wied.	..	3	..	3
n*_Anopheles subpictus_ Grassi	..	2	..	2
*_An. subpictus indefinitus_ (Lud.)	..	40	..	40
Anopheles vestitipennis D. and K.	7	..	..	7
n*_Culex americanus_ (N.-L.)	..	..	3	3
*_Culex annulirostris_ Skuse	..	22	..	22
n*_Culex fuscocephalus_ Theob.	..	4	..	4
n _Culex peus_ Speiser	..	3	..	3
Culex pipiens L.	..	4	..	4
*_Culex sitiens_ Wied.	..	8	..	8
Culex tarsalis Coq.	..	3	..	3
n*_Culex tritaeniorhynchus_ Giles	..	6	..	6
n*_Culex univittatus_ Theob.	1	..	..	1
n*_Culex whitmorei_ (Giles)	..	65	..	65
n*_Culiseta annulata_ (Schrank)	1	..	..	1
Culiseta inornata (Will.)	..	1	..	1
n*_Mansonia crassipes_ (V.d.W.)	..	1	..	1
n*_Mansonia dives_ (Schiner)	1	1	..	2
n _Mansonia flaveola_ (Coq.)	9	..	..	9
*_Mansonia humeralis_ D. and K.	9	..	..	9
*_Mansonia pseudotitillans_ (Theob.)	1	..	..	1
n*_Mansonia uniformis_ Theob.	..	10	..	10
Number of specimens	258	267	4	529
Number of species	20	31	2	51

* Asterisk indicates species not known to occur in any of three areas considered.
n—Species new to our aircraft inspection records.

transmitters, for instance, conceivably could have serious consequences.

SUMMARY. Problems and practices involved in preventing escape of live mosquitoes and other insects of public health importance which are accidentally transported to the United States on aircraft are mentioned. Entomological findings, with particular reference to mosquitoes are discussed.

During the 13-year period ending June 30, 1960, more than 20,000 mosquitoes were found on arriving aircraft, in addition to a large number of other insects. Fifty-one of 92 mosquito species found are not known to occur in one or more of the three general areas (Continental United States, Hawaii, and Puerto Rico) where the aircraft disinfestation program is conducted. Four of the non-indigenous species, *Anopheles grabhamii, Anopheles neomaculipalpus, Anopheles vestitipennis,* and *Culex tarsalis* were alive when found.

Results point up the need for continuation of this preventive program to meet the threat of entry and establishment of exotic medically important insects in this country.

ACKNOWLEDGMENTS

Grateful acknowledgment is made of the work of entomologists at the quarantine stations who conducted the program upon which this paper is based and to entomologists at the U. S. National Museum who made many of the taxonomic determinations.

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BULLETIN NUMBER 4

One of the public services which members of AMCA should always be ready and willing to perform is to give authoritative information to public officials on how to organize for mosquito control. AMCA Bulletin Number 4, entitled "Organization for Mosquito Control" is designed to assist in performing this service. It is now available at $2.00 a copy from the office of the Executive Secretary, Mr. T. G. Raley, P. O. Box 278, Selma, California.

Edited by Harold F. Gray, assisted by many other AMCA members, and with a foreword by Dr. Fred L. Soper, this Bulletin conveys up-to-date, specific answers to the many questions that confront persons and groups who are interested in or charged with organizing for mosquito control. Chapter headings include "Why Organize," "How To Organize," "Financing," "State-wide Legislation" and other topics, and there are appendices of helpful references and sources of information.

ANOPHELES SACHAROVI (FAVRE 1903) IN TURKEY

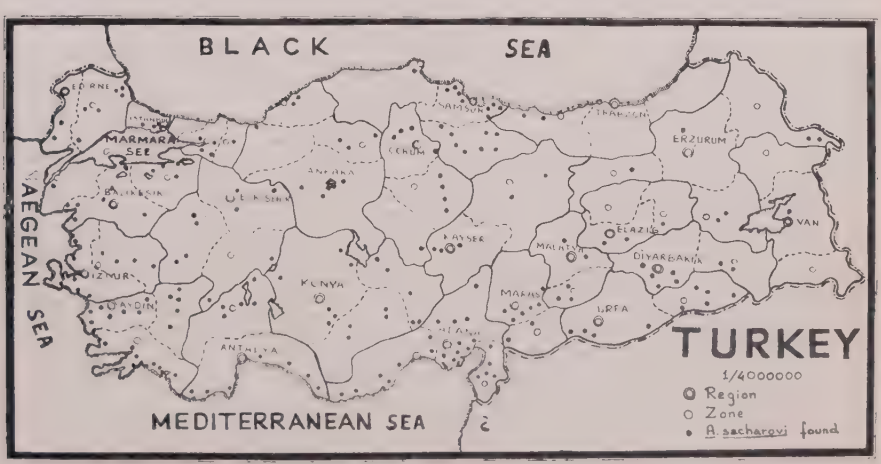
C. GÖKBERK, M.D.
Malaria Institute, Adana, Turkey

According to the surveys made before 1925, prior to the establishment of the Malaria Control Organization and following the epidemiological and entomological investigations carried out by the staff of the Organization, there were ten different *Anopheles* species in Turkey. These *Anopheles* were *sacharovi* (Favre 1903), *maculipennis* (Meigen 1818), *hyrcanus* (Pallas 1771), *claviger* (Meigen 1804), *algeriensis* (Theobald 1903), *plumbeus* (Stephens 1818), *marteri* (Senevet and Prunelle 1927), *superpictus* (Grassi 1899), *multicolor* (Cambouliu 1902), *sergenti* (Theobald 1907). Of these, the most important vector of malaria is *sacharovi*. The secondary vector is *superpictus*. Although *claviger* and *sergenti* play an important role in the transmission of malaria in the neighboring countries of Israel and Jordan, and are found in malaria transmission areas in Turkey, the majority of *Anopheles* present are *sacharovi*.

A. sacharovi is widely distributed throughout Turkey. However, in coastal plains and near the marshy areas, it is often found breeding with *maculipennis melanoon* (*Hackett* 1934) and *maculipennis messeae* (Falleroni 1926). Toward the Anatolian Plateau, it is found with *maculipennis typicus* (Hackett and Missiroli 1935) and *superpictus*. *A. hyrcanus*, *A. sergenti* and species of *Uranotaenia*, *Culiseta* and *Culex* may also be found with *sacharovi*.

EGGS. Eggs of *A. sacharovi* are light grey in color, usually without floats. Those found in the spring may have rudimentary floats. The eggs found in the surrounding breeding places of Lake Van (1.720 m.) had floats.

LARVAE. The hatching of larvae usually takes 1–2 days, according to the local summer temperature. Breeding places of larvae vary in different areas. In the southern and western coastal areas of Turkey, breeding takes place near the sea, in saline waters, in streams, in small lakes and ponds formed by lagoons and in brackish waters, in rice field irrigation canals, near river banks, lakes, in water next to wells, in water collected in horse footprints, in ponds, and barrage lakes.



They can be found together with *A. superpictus* in pools of mountain torrents during summer. *A. sacharovi* also breed on high land up to 1,720 meters in the Van region and it can be found in springs, lakes or drains and in breeding places next to mountain lakes. Breeding places have generally clean, still and sunny waters, with green vegetation. When they cover extensive areas and especially where there is irrigation, it is almost impossible to control the breeding of larvae.

ADULTS. In the Middle East, *A. sacharovi* feeds mostly on man and other domestic animals. It is found abundantly in stables. Following the last ten years of DDT spraying, *A. sacharovi* recently began to show a tendency to be less domestic in habits. By resting in caves in Savur in the East of the Country, in Adana Region in the South, they cause outdoor transmission. Insecticide spraying does not cause their complete disappearance, but where insecticide spraying is neglected they increase abundantly. They hibernate as adults in stables where hundreds of them may be collected. It is also possible to find a great number of *A. sacharovi* specimens in Maras region, due presumably to DDT resistance.

They are found resting on ceilings and walls of stables above one meter from the floor in half shaded places, along with *A. hyrcanus, A. superpictus,* and others. They are also found in rooms of houses, in darkish corners, inside cupboards, between objects hanging from walls, in back of and beneath furniture, and in other similar situations.

ANOPHELES DISTRIBUTION AND ITS RELATION TO THE MALARIA ERADICATION PROGRAM IN CENTRAL NEPAL

HAROLD W. BRYDON,[1] GOVIND JOSHI,[2] AND SHREEDHAR PRADHAN[3]

The high Himalayan Kingdom of Nepal is not spared the devastation of malaria (Karan and Jenkins, 1960), which for centuries has plagued, hampered and killed the Nepalese people. Starting in 1952, the United States foreign aid program, working in collaboration with the Nepalese government, undertook a small malaria control project especially to assist the people living in the hyperendemic areas. It was at this time that the first efforts were made to survey the mosquito population and discover the vectors.

The initial steps in malaria control proved most successful. As time passed, the control program steadily increased in magnitude. Then, with the intensity of malaria eradication programs increasing throughout the world, with the neighboring successful Indian eradication program progressing favorably and with a World Health Organization pilot project proving very successful in Nepal, it was felt that a Nepalese eradication program was not only feasible, but would prove more advantageous to Nepal than a control program. Therefore, in December 1958 two coordinated bilateral agreements were signed between His Majesty's Government of Nepal, the World Health Organization (WHO) and the United States International Cooperation Administration (ICA) to undertake a malaria eradication project in Nepal.

For the purposes of the eradication program, the country was divided into three zones consisting of an Eastern Zone,

[1] Entomologist Advisor, International Cooperation Administration.
[2] Chief Entomologist, Nepal Malaria Eradication Organization.
[3] Entomologist, Nepal Malaria Eradication Organization.

FIG. 1.—Map of Nepal, showing the zonal divisions, and the sector division of the central zone.

Central Zone and Western Zone (Figure 1). Since money and trained manpower were not sufficient to include the entire country immediately, it was decided to confine the first phase of the program to the Central Zone. This zone was then divided into three sectors which were referred to as North Sector, Middle Sector, and South Sector, and each sector was, in turn, divided into subsectors. A National Headquarters, situated in Kathmandu, was established to serve as the governing and unifying body to the organization.

The entomological data which had been accumulated during the control project and the WHO pilot project were utilized as guidelines and supportive intelligence in developing and conducting the eradication project. Both routine and random mosquito collections were conducted during the pre-eradication phase of the program as a part of the effort to obtain further pertinent eradication data. As a result of these collections, a total of thirty-one species of *Anopheles* mosquitoes have been collected in the Central Zone since the inception of the control and eradication programs. Their distribution in each of the districts of the Central Zone appears in the accompanying chart (Figure 2). Specialists with both the World Health Organization and the U. S. National Museum have on occasion furnished species confirmation on new or doubtful collections.

During the years preceding the eradication program, *Anopheles fluviatilis* and *Anopheles minimus* were incriminated as vectors of malaria. This has since been reconfirmed during the eradication program. *A. fluviatilis* is the primary vector of malaria in the hilly regions which are mostly in the North Sector (Figure 3). *A. minimus* is the primary vector and *A. fluviatilis* the secondary vector in the forested and forest fringe areas which comprise the mid-terai regions which pass predominantly through the Middle Sector. *A. minimus* is also a vector in certain parts of the South Sector; however, much of the South Sector is in the terai or

Anopheles Species	CENTRAL ZONE DISTRICTS															
	North Sector						Middle Sector				South Sector					
	West No. 1	West No. 2	West No. 3	East No. 1	East No. 2	Kathmandu	Nawalpur	Butawal	Chitawan	Chisapani Garhi	Parsa	Bara	Rautahat	Sarlahi	Sindhuli Garhi	Mahotari
aconitus			x				x	x	x	x	x	x				
aitkenii					x	x						x				
annandalei			x							x						
annularis	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
barbirostris	x			x	x	x	x	x	x	x	x	x	x			
culicifacies	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
filipinae			x													
fluviatilis	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
gigas						x				x						
hyrcanus	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x
jamesii			x							x						
jeyporiensis			x	x			x		x	x	x	x	x		x	x
karwari										x						
lindesayi	x	x	x		x	x	x			x		x	x			
maculatus	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
majidi							x			x						
mangyanus															x	
minimus	x				x		x	x	x	x	x	x	x	x	x	x
pallidus			x		x			x	x	x	x		x	x		x
philippinensis							x	x				x	x	x		
ramsayi							x	x								
sinensis						x				x						
splendidus	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
stephensi										x						x
subpictus	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
tessellatus				x	x	x	x	x			x	x				
theobaldi			x							x						
turkhudi				x	x				x	x		x				
umbrosus										x						
vagus	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x
varuna								x	x	x						

FIG. 2.—The different species of Anopheles which have been collected from the various Districts of the Central Zone are indicated by an "X" under the District name.

open unforested area, similar to the adjacent plain area of Northern India and neither *A. fluviatilis* nor *A. minimus* are extensively found there. *Anopheles culicifacies* is abundantly and extensively found in the open plain area of the South Sector and, even though it has so far not been incriminated in Nepal, it is a proven vector in similar adjacent areas in India (Bhatia and Krishnan, 1957 and Puri, 1955). Therefore, it has been assigned to the category of suspected vector in Nepal. As seen in Figure 3, *A. fluviatilis*, *A. minimus* and *A. culicifacies* form distinct east-west belts, which, however, overlap slightly where the density is about equal.

Since the East-West belts of terai, mid-terai and hilly regions extend into both the East and West Zones of Nepal, it is expected that a distribution pattern of the present predominant vector and suspected vector species will be developed which is similar to the one which has been established in the Central Zone. Perhaps new *Anopheles* species will also be found as

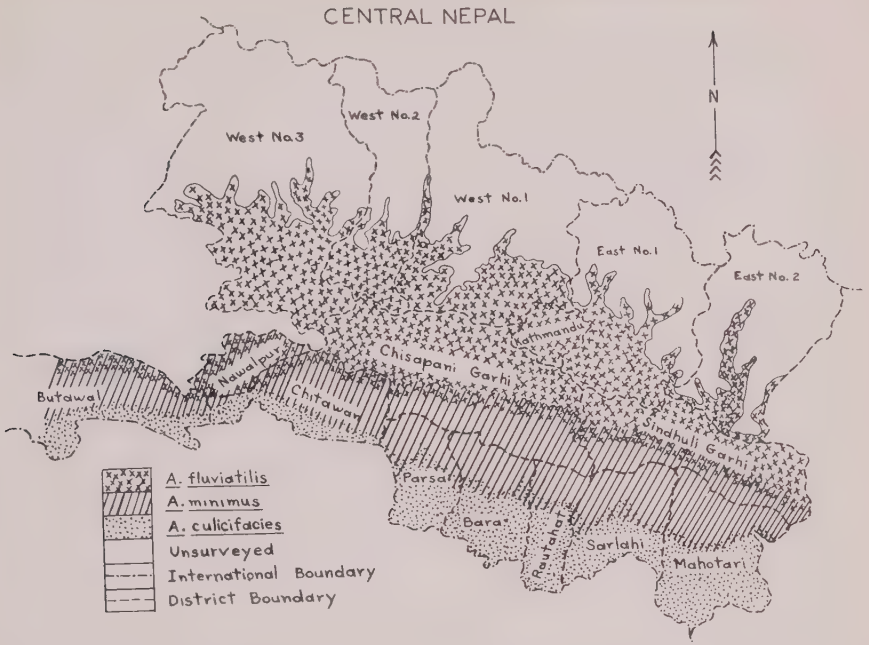


FIG. 3.—Map of the Central Zone of Nepal showing the distribution of the predominant vectors and suspected vector in each District.

new distribution records are made. In the past, many specimens of *Anopheles* species, other than the vectors and suspected vectors, have been dissected for sporozoites and even though they have not proven positive, it is conceivable that as the program progresses additional vectors of malaria will be found in Nepal.

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Watch for information on the Galveston Meeting in the September and December issues: Galveston, Texas, March 5, 6, 7, 1962. Almost anything in Texas is certain to be big and impressive, and the AMCA Meeting will be no exception.

A LIST OF THE MOSQUITOES OF LIBYA

WILLIAM J. GOODWIN [1, 2]

Information on the mosquitoes found in Libya is not readily available as it appears only in rare Italian and French publications. The purpose of this article is to review the literature on the Culicidae indigenous to Libya and to record the species of mosquitoes collected by the writer and others since 1957.

Brighenti (1930) listed the anopheline mosquitoes collected by the Italian workers in Tripolitania. La Face (1936) reviewed the available literature and recorded the anopheline species collected from various parts of Libya with primary emphasis on Tripolitania and Cyrenaica.

Vermeil (1935) recorded the species collected by various French workers in the Fezzan. He also recorded the collection of *Anopheles (Cellia) broussesi* Edw. from Gat, Fezzan. This is the only record of this species occurring in Libya.

Senevet and Andarelli (1956) listed the species of anophelines found in North Africa. This publication contains a description of each species including egg, larval and adult morphology; and the biology of each species including larval habitat, association with other Culicidae, hibernation, degree of domesticity, geographical range, anthropophilic or zoophilic, and its role as a vector of malaria.

Rioux (1958) listed the Culicidae found in the Middle Mediterranean Region. This publication also includes the taxonomy, morphology, and biology of each species. The majority of the culicine mosquitoes found in Libya are listed in this publication.

Goodwin and Paltrinieri (1959) described the epidemiology of oases malaria and listed the anopheline mosquitoes responsible for transmission of malaria in oases as well as in the coastal regions of Libya.

Libya is situated between 20 degrees and 33 degrees north latitude, and between 9 degrees and 25 degrees east longitude. It is bounded on the north by the Mediterranean Sea, on the west by Tunisia and Algeria, on the south by French Equatorial Africa, French West Africa, and Sudan, and on the east by Egypt. The inset map on Figure 1 shows the location of Libya in relation to other African countries. There are over 1,200 miles of coastline and the total land area is 683,000 square miles. The country is arid and composed largely of rocky and sandy deserts. A narrow oasis-like coastal belt extends for 30 to 40 miles inland in which the majority of the agriculture of the country is found. Beyond the coastal belt is the "Gebel" or mountain range which is approximately 2,000 feet high. The mountains in Tripolitania are barren and rocky whereas those of Cyrenaica are covered with considerable vegetation. Southward the "Gebel" descends into the rock and sand expanse of the remainder of Libya. There are no rivers in the country and very few flowing streams.

The only permanently inhabited areas in the desert are the oases. These consist of isolated areas of vegetation composed of palm trees, alfalfa and barley. These oases are arranged in long relatively narrow, broken lines with an east-west orientation. They occur where the water table is sufficiently near to the surface to support the growth of palm trees and to permit the digging of shallow wells to supply water for man, his animals, and for irrigation.

The annual rainfall varies from an average of 14.5 inches along the coast to 0.5 inch in the true desert. The temperature along the coastal belt ranges from

[1] Scientist (R), United States Public Health Service and Malaria Advisor, International Cooperation Administration.

[2] The author is indebted to Dr. Alan Stone, Entomological Research Division, U. S. Department of Agriculture, for identification of certain species and for the verification of identification of all others.

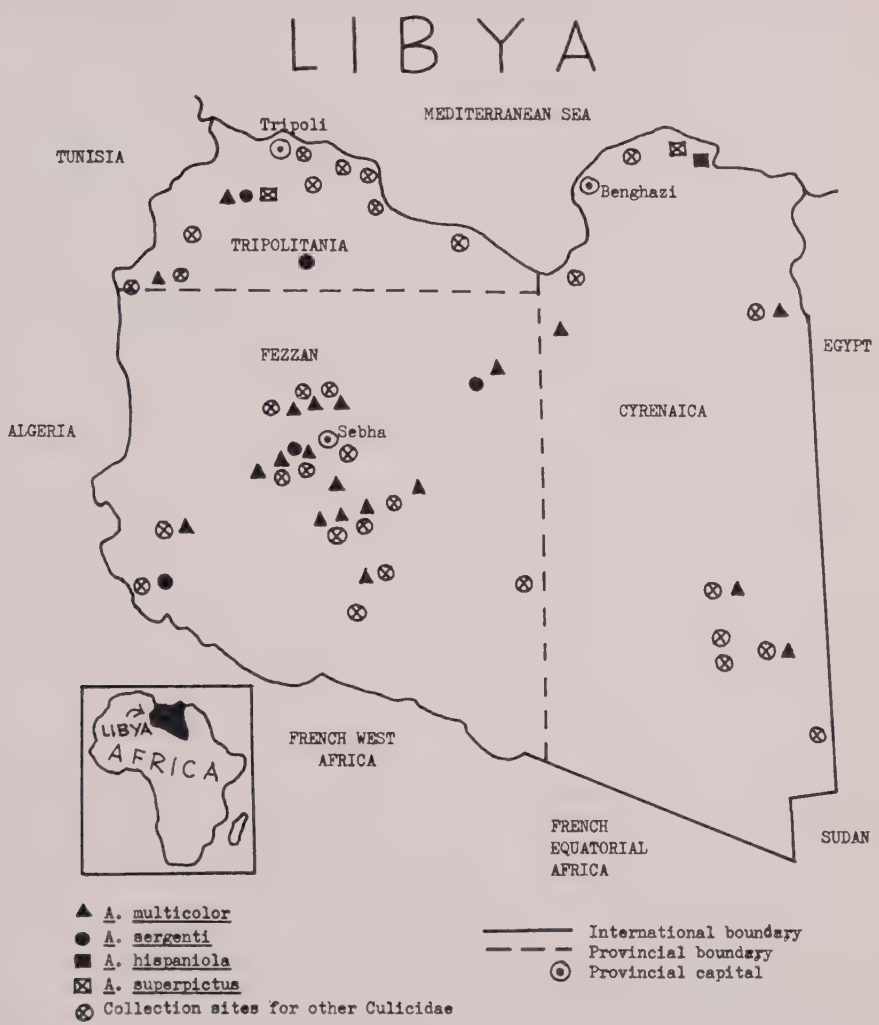

FIG. 1.—Map of Libya showing the distribution of the more important Anophelines and collection sites for other species of mosquitoes

43° F. in winter to 113° F. in summer. The temperatures in the desert range from 30° F. to 125° F.

There are approximately 1,200,000 inhabitants in Libya. The population is composed of Arab, Berber, Taureg, Negro and other ethnic groups. Europeans, including Italians, Greeks, and others, are found primarily in the cities. A large portion of the population is nomadic or semi-nomadic.

The following is a list by province of the species of mosquitoes reported from Libya by various workers prior to 1957; the letter symbols used are explained at the end of the list.

Genus *Anopheles*

(Cellia) multicolor Camb. (C) (F); (L) (V)
(Cellia) sergenti (Theob) (C) (F); (L) (V)
(Anopheles) hyrcanus (Pallas) (C); (S)
(Cellia) superpictus Grassi (C) (F); (L) (V)
(Cellia) hispaniola Theob. (E); (V)
(Cellia) broussesi Edw. (F); (V)
(Anopheles) algeriensis Theob. (T); (B) (L)
(Anopheles) coustani Laveran (T); (B) (L)
(Anopheles) lanbranchiae Fall. (T); (B)
(Cellia) pharoensis Theob. (T); (L)
(Anopheles) claviger (Meig) (T); (B) (L)
(Anopheles) sacharovi Favre (T); (U)
(Anopheles) coustani var. *ziemanni* Grunberg (T); (U)

Genus *Culex*

(Culex) pipens L. (C) (F) (T); (R)
(Culex) univittatus Theob. (F); (R)
(Culex) laticinctus Edw. (T) (U)
(Barraudius) pusillus Macq. (F) (T); (R)
(Neoculex) deserticola Kirkpatrick (T); (U)

Genus *Culiseta*

(Allotheobaldia) longiareolata (Macq.) (F) (R)

Genus *Aedes*

Aedes (Ochlerotatus) mariae. Sergent and Sergent (F); (V) (R)
Aedes (Ochlerotatus) caspius (Passal) (F) (T); (R)
Aedes (Ochlerotatus) detritus (Hal.) (T); (R)

Genus *Uranotaenia*

Uranotaenia unguiculata Edw. (T); (U)

During the period from February 1957 to July 1960, the writer and other malaria eradication personnel conducted extensive surveys on the insect vectors of human diseases in addition to pre-eradication malaria surveys in all parts of Libya. The major emphasis was on the collection of anopheline mosquitoes in connection with the pre-eradication surveys. Culicine mosquitoes were collected whenever possible. All these specimen mosquitoes were collected by dipping for larvae and examining the native houses for adults. Light traps or animal traps were not used. The following is a list by province of the species of mosquitoes collected from 1957–1960.

Genus *Anopheles*

(Cellia) multicolor Camb. (C) (F) (T) (36)
(Cellia) sergenti (Theob.) (C) (F) (T) (16)
(Cellia) superpictus Grassi (C) (T) (5)
(Cellia) hispaniola Theob. (C) (3)
(Anopheles) algeriensis Theob. (T) (1)
(Anopheles) coustani var. *tenebrosus* Donitz. (T) (1)
(Anopheles) marteri Senevet and Prunelle (C) (1)
(Anopheles) hyrcanus (Pallas) (T) (2)

Genus *Culex*

(Culex) univittatus Theob. (F) (T) (10)
(Culex) theileri Theob. (T) (1)

Genus *Culiseta*

(Allotheobaldia) longiareolata (Macq.) (C) (F) (T) (6)

Genus *Aedes*

(Ochlerotatus) dorsalis (Meig) (F) (2)
(Ochlerotatus) detritus (Hal.) (C) (1)
(Ochlerotatus) caspius (Pallas) (C) (1)

Genus *Uranotaenia*

Uranotaenia unguiculata Edw. (F) (T) (4)

Symbols: (C) Cyrenaica; (F) Fezzan; (T) Tripolitania; (B) Brighenti 1930; (L) LaFace 1936; (R) Rioux 1958; (S) Senevet 1956; (V) Vermeil 1953; (U) ICA Health Staff. (Numbers) Numbers of localities where species were found.

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OVIPOSITION RESPONSES OF *CULEX PIPIENS QUINQUEFASCIATUS* SAY TO WATERS TREATED WITH VARIOUS CHEMICALS

C. M. GJULLIN

Entomology Research Division, Agric. Res. Serv., U.S.D.A., Corvallis, Oregon [1]

The female mosquito's choice of oviposition site is influenced by many factors. Among the species that lay their eggs singly or in rafts on the surface of the water, this choice may be affected by type of vegetation, degree of shade, and amount of protection from wind and wave action. The choice of oviposition site will also be affected by the physical and chemical properties of the water available.

The chemicals present in different types of water that may influence the female's choice of oviposition site have not been extensively investigated. Lund (1942) in studies of *Anopheles quadrimaculatus* Say found no evidence of any preference in water samples containing a series of different chemicals or differing in hardness, pH, and calcium ion concentration. Wallis (1954) showed that *Aedes aegypti* (Linnaeus) was repelled by a 3 percent salt solution but preferred a 0.25 percent salt solution over distilled water. A 1 percent sodium chloride solution was shown by Zuleta (1950) to be repellent to *Culex fatigans* Wied. (*Culex pipiens quinquefasciatus* Say) but a 1 percent magnesium solution was not. He also found that this species preferred well-matured grass infusion to rainwater. Gerhardt (1959) found that *Culex peus* Speiser laid eggs in field-test plots which contained fermenting dog food, casein, fat, or sugar and did not lay eggs in an untreated control plot. *Culex tarsalis* Coq. and *Anopheles freeborni* Aitken also laid eggs in these plots as fermentation subsided, but not in the control plots.

Materials and Methods.—One hundred and fifty-one chemicals were tested in water samples against gravid females of *Culex pipiens quinquefasciatus* Say to determine if they were attractive or repellent.[2] Some comparative tests of the attractiveness of natural breeding and distilled waters were also made.

The tests were made in screen cages measuring 12x12x12 inches that were fitted with a cloth sleeve on one side. Twenty to 25 blood-fed females, not over 5 days old, were used in each test. Acetone or water solutions of the chemicals were added to 350 cc. of distilled water in 400-cc. beakers. The chemicals were tested at 5, 25, and 50 p.p.m. In the multiple-choice tests three beakers containing different strengths of the chemical and one containing distilled water were used. The beakers were placed in the four corners of the cage. In the single-choice tests one beaker containing the chemical in 350 cc.

[1] A cooperative project between the Entomology Research Division of the U. S. Department of Agriculture and the Bureau of Vector Control of the California Department of Health. San Standring and Claude Hirst of the Bureau of Vector Control assisted with the project.

[2] Most of the chemicals tested were synthesized by chemists of the Entomology Research Division.

of water was used. A 10 percent sugar solution was available as food in all cages. The beakers containing the test solutions were placed in the cages on the second or third day after the females had taken their blood meal and removed 4 or 5 days later.

The cages were held in a room measuring 5x5x6 feet and lighted by one 100- and one 7½-watt bulb. The large bulb was turned on from 6 a.m. to 6 p.m. and the small one from 4 a.m. to 8 p.m. An air conditioner provided continuous moderate exchange of fresh air.

Results and Discussion.—In the multiple-choice tests in which the mosquitoes could deposit eggs in distilled water or in different concentrations of the chemical, 26 compounds appeared to be effective in preventing oviposition at 50 p.p.m. or less. The results are presented in Table 1.

The effectiveness of some of the above chemicals was explored in additional tests in which a single chemical solution was the only one present in the cage. Several of these were effective in preventing egg deposition at concentrations of 10 p.p.m. or less, but none at 1 p.p.m. The results of these tests are shown in Table 2.

Several surfactants were found to prevent oviposition at 10 p.pm. when single beakers were offered for egg deposition. The most effective of the series tested was Triton X-155. This material was effective at 2 p.p.m. in distilled water. The results of these tests are shown in Table 3.

This species of female mosquito rests on the surface of the water while laying her eggs. It seemed possible that the repellent action of some of the surfactants might be due to the reduction of surface tension

TABLE 1.—Results with compounds that appeared to reduce *Culex pipiens quinquefasciatus* egg deposition in multiple-choice tests

Compound	Number of egg rafts at indicated dosage in p.p.m.[a] during 4-day exposure period		
	0	5	25
Acetonitrile, 2-allyl-4,5-methylenedioxyphenyl-	6	3	0
Allethrin	1	0	0
Benzoic acid, *o*-chloro-, 4-methylcyclohexyl ester	2	1	0
Benzoic acid, *o*-chloro, *o*-tolyl ester	1	0	0
Butyric acid, 3-(*m*-methoxyphenoxy)-, propyl ester	6	0	0
Chrysanthemumic acid, benzyl ester	4	2	0
Chrysanthemumic acid, 2,4-dimethylbenzyl ester	5	3	0
Chrysanthemumic acid, *m*-ethoxybenzyl ester	4	0	0
Chrysanthemumic acid, *p*-methoxybenzyl ester	5	0	0
Chrysanthemumic acid, *o*-methylbenzyl ester	1	0	0
Chrysanthemumic acid, 3,4-methylenedioxyphenethyl ester	6	0	0
Chrysanthemumic anhydride	4	2	0
4-Cyclohexene-1,2-dicarboximide,*N*-octyl-	6	2	0
Ether, gamma-bromopropyl *m*-methoxyphenyl	4	6	0
m-Toluamide, *N,N*-dibutyl-	7	1	0
m-Toluamide, *N,N*-diisopropyl-	11	1	0
m-Toluamide, *N,N*-dipropyl-	2	3	1
Oleic acid	9	3	0
Oleic acid, butyl ester	3	3	1
o-Veratrylamine, *N*-ethyl-*N*-heptyl-	6	1	0
Phosphonic acid, ethyl-, ethyl ester, anhydride with chrysanthemumic acid	2	2	3
Piperonal, 6-allyl-	2	2	0
1-Propanol, 2-amino-3-isobornyloxy-2-methyl-	3	3	0
Propionic acid	5	3	4
Succinamic acid, *N,N*-dipropyl-, *sec*-butyl ester	1	1	0
Succinic acid, 2-piperonyl-, 4-ethyl 1-propyl ester	3	4	0

[a] No egg deposition at 50 p.p.m.

TABLE 2.—Egg deposition by *Culex pipiens quinquefasciatus* in cages containing a single compound in distilled water (no-choice tests)
(Average of one to three tests per concentration)

Compound	Number of egg rafts at indicated dosage in p.p.m. during 4-day exposure period					
	50	25	10	5	2	1
Acetonitrile, 2-allyl-4,5-methylenedioxyphenyl-	1	..	..	..	..	..
Allethrin	..	..	..	0	..	..
Barthrin	..	..	0	..	..	..
Benzoic acid, *o*-chloro, 4-methylcyclohexyl ester	0	0	..	1	..	..
Benzoic acid, *o*-chloro-, *o*-tolyl ester	5	..	..	..	..	..
Butyric acid, 3-(*m*-methoxyphenoxy)-, propyl ester	3	..	..	..	..	..
Chrysanthemumic acid, benzyl ester	2	..	..	..	..	..
Chrysanthemumic acid, 2,4-dimethylbenzyl ester	0	0	0	3	..	..
Chrysanthemumic acid, 3,4-dimethylbenzyl ester	..	..	..	2	..	..
Chrysanthemumic acid, *m*-ethoxybenzyl ester	0	..	..	0	..	1
Chrysanthemumic acid, *m*-isopropoxybenzyl ester	0	..	..	1	..	..
Chrysanthemumic acid, *p*-methoxybenzyl ester	..	..	..	0	1	..
Chrysanthemumic acid, *o*-methylbenzyl ester	0	0	..	0	2	..
Chrysanthemumic acid, 3,4-methylenedioxyphenethyl ester	5	..	..	..	..	..
Chrysanthemumic anhydride	6	..	..	..	..	..
4-Cyclohexene-1,2-dicarboximide,*N*-octyl-	3	..	..	..	..	..
Ether, gamma-bromopropyl *m*-methoxyphenyl	3	..	..	..	..	..
Fencholic acid, piperonyl ester	0	..	..	2	..	..
Malathion	..	..	2	1	..	..
Oleic acid	11	..	..	..	..	..
Oleic acid, butyl ester	3	..	..	..	..	..
Phosphonic acid, ethyl-, ethyl ester, anhydride with chrysanthemumic acid	2	..	..	..	..	..
Piperonal, 6-allyl-	2	..	..	..	..	..
1-Propanol, 2-amino-3-isobornyloxy-2-methyl-	3	..	..	..	..	..
Propionic acid	2	..	..	..	..	..
Succinamic acid, *N,N*-dipropyl-, *sec*-butyl ester	2	..	..	..	..	..
Succinic acid, 2-piperonyl-, 2-ethyl 1-propyl ester	3	..	..	..	..	..
m-Toluamide, *N,N*-dibutyl-	0	..	..	..	..	..
m-Toluamide, *N,N*-diisopropyl-	0	..	..	4	..	..
m-Toluamide, *N,N*-dipropyl-	1	..	..	..	..	..
o-Veratrylamine, *N*-ethyl-*N*-heptyl-	0	..	..	3	..	..

so that the water surfaces would no longer support the weight of the female. Reduction of surface tension might also conceivably affect the repellency of these materials in other ways. Surface tension determinations were therefore made of a number of the repellent and nonrepellent surfactants in this series (Table 3). The surface tensions of the nonrepellent surfactants were found to extend below those of the repellent materials. This would indicate that reduction of surface tension does not prevent the female from resting on the surface of the water.

Partial mortality of adults occurred in a number of cages in this series when toxic materials were used. Some of the more effective repellents caused partial mortality at low dosages and others did not.

Beechwood creosote and *N*-butyl-*N*-ethly-*o*-veratrylamine were the only compounds of the 151 tested that appeared to increase the attractiveness of distilled water. A review of the literature relating to the use of creosote for insects by Hocking (1960) shows that it has been widely used as a repellent for several insects but has not previously been found to be attractive. Both creosote and *N*-butyl-*N*-ethyl-*o*-veratrylamine were more than three times as attractive as distilled water. Comparative tests of water from a pond where *C. p. quinquefasciatus* was breeding showed that the pond water was also more attrac-

TABLE 3.—The repellent effect of surfactants on oviposition of *Culex pipiens quinquefasciatus* when single beakers were available per cage. Average of one to three tests per concentration

Surfactants [a]	Number of egg rafts at indicated dosages in p.p.m. during 4-day exposure period			Surface tension (Dynes per cm. at 10 p.p.m.)
	10	2	1	
Alkaterge C	1	..	..	27.8
Antarox A-200	0	..	1	..
Atlas 32344	12	..	..	34.9
Atlox 1045A	6	..	..	..
B-1956	3	..	..	..
D-40-FG	3	..	..	..
Igepon AP-76	1	..	..	..
OPE 1	12	..	..	..
Renex 20	3	..	..	44.1
Santomerse DT	5	..	..	..
Span 20	10	..	..	42.3
Tergitol NPX	0	2	..	..
Triton CF21	0	4	11	40.7
Triton F10	0	4	3	40.7
Triton Gr-5	3	..	..	53.6
Triton QS-15	3	..	..	59.3
Triton X-45	4	..	..	40.1
Triton X-100	0	12 [b]	3	53.6
Triton X-151	0	..	12	44.5
Triton X-155	0	0	1	31.9
Triton X-161	1	..	..	50.0 [c]
Triton X-171	8	..	..	50.0
Triton X-300	9	..	..	55.0
Triton X-301	7	..	..	..
Triton 114	1	..	..	..
Tween 20	4	..	..	..
Tween 80	5	..	..	..
Tween 618	8	..	..	45.2
Vatsal OT	2	..	..	..
Triton X-100 + *o*-methylbenzyl ester of chrysanthemumic acid, 1:1 ratio	11	3	13	..

[a] The inclusion of proprietary names of chemicals does not imply the endorsement of the U. S. Department of Agriculture.

[b] Effective (no egg rafts) at 5 p.p.m.

[c] Distilled water 68 dynes/cm. Temperature 74–78° F.

TABLE 4.—Relative attractiveness of distilled water and various solutions for *Culex pipiens quinquefasciatus* oviposition. Four replications per solution

Material	Total number of egg rafts laid at indicated dosage in p.p.m. during 4-day exposure period			
	50	25	5	0
N-butyl-*N*-ethyl-*o*-veratrylamine	11	11	11	3
Beechwood creosote	18	13	12	5
Comparison of pond and distilled water				
Pond [a]	..	..	..	37
Distilled	..	..	..	8

[a] From a grassy pond where *C. pipiens quinquefasciatus* were breeding.

tive than distilled water. The results of these tests are shown in Table 4.

The materials that were found to prevent or reduce oviposition in this study might not be practical under field tests because of their cost and short period of effectiveness. However, the results obtained suggest that effective chemicals might be found. The possibility of finding effective repellents for other mosquito species because of their more limited range of breeding conditions in nature seems even more favorable.

SUMMARY. One hundred and fifty-one chemicals were tested in water samples against gravid *Culex pipiens quinquefasciatus* Say to determine if they were attractive or repellent. Thirty-three of these materials prevented oviposition at 50 p.p.m. or less in distilled water in single-beaker cage tests. Thirteen were effective at 10 p.p.m. or less but only Triton X-155 (a surfactant) was effective at 2 p.p.m. Beechwood creosote and *N*-butyl-*N*-ethyl-*o*-veratrylamine were the only compounds that increased the attractiveness of distilled water.

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SOME OBSERVATIONS ON BITING FLIES ATTACKING SHEEP

ROBERT HENRY JONES [1]

Livestock Insects Investigations, Ent. Res. Div., Agric. Res. Serv., U.S.D.A., Kerrville, Texas

With the initiation of studies by the U. S. Department of Agriculture on the transmission of bluetongue disease of sheep with the fly *Culicoides variipennis* (Coquillett), one of the important steps in incriminating this species as the vector was establishing that it attacked sheep in the field. An examination of the literature showed no published records of *variipennis* biting sheep. In the fall of 1960 a number of field collections were made with a portable animal-bait trap, using a sheep. This paper presents some of the records obtained; these were made near Grand Junction, Colo.,[2] on the western slope of the Continental Divide.

The animal-bait trap consisted of an 8-foot-square piece of olive-drab canvas stretched on a pipe frame, and a pyramidal white cloth tent whose base was attached to an 8-foot-square pipe frame of lighter construction. These two frames were hinged together along one side, and in the open position they lay on the ground side by side. The frames were connected by heavy springs, and the tent side was held down with a weight. A sheep was staked out in the center of the canvas, and the trap was sprung from a distance to avoid contamination by human odor. As soon as the trap was closed the flies were collected, with special attention being given to those that remained engorging on the sheep.

This study was preliminary, since methodology was being developed at the same time for serological work, and for epidemiological studies in which many of

[1] The Simuliidae were determined by Alan Stone of this Division, who also corrected the author's determinations of the Culicidae. The author is indebted to his assistant, J. E. Wright, for his help in both the design and construction of the animal-bait trap.

[2] At the Leo James farm.

TABLE 1.—Freshly engorged biting flies collected from animal-bait-trap on Sept. 8–10 and Oct. 5–9

Species	Flies observed feeding	
	Number collected	Body region
Culicoides variipennis (Coquillett)	5	sheared belly area
" *stonei* James	..	..
Leptoconops kerteszi Keiffer	common	inside ear
Simulium vittatum Zetterstedt	10	inside ear
" *piperi* Dyar & Shannon	2	sheared belly area
Aedes dorsalis (Meigen)	..	..
" *vexans* (Meigen)	1	leg
" *nigromaculis* (Ludlow)	..	..
Culiseta inornata (Williston)	..	..

the flies collected were held for three days to allow time for the complete digestion of any recent blood meal. Thus, collection of mosquitoes was frequently neglected, though they were commonly observed biting the sheep. The use of light was minimized after sunset to avoid attracting insects by phototropism.

For all the collections here listed, the trap was located in approximately the same spot, a corral area where the ground was bare and brown. In September the days were clear and sunny with little or no wind. In October, the 5th, 6th, and 7th were mostly clear with moderate wind in occasional gusts, and the 8th and 9th were quite cloudy with fairly strong gusts of wind and occasional light rain.

In Table 1 are listed the freshly engorged biting flies collected from the animal-bait trap on September 8–10 and October 5–9. The body region used for feeding is noted if the specimens were seen engorging.

In addition to the above, the following species were represented by specimens that were not freshly engorged: *Culicoides hieroglyphicus* Malloch, *haematopotus* Malloch, and *stellifer* (Coquillett); *Simulium griseum* Coquillett and *arcticum* Malloch; *Aedes melanimon* Dyar; *Anopheles pseudopunctipennis franciscanus* McCracken; *Stomoxys calcitrans* (L.); and *Siphona irritans* (L.).

Table 2 gives some records of *C. variipennis* collected. Until the sheep in the trap was sheared, specimens of this species were not seen engorging, though they were commonly noted flying up at the belly and alighting there. After shearing, a total of 8 specimens was actually seen engorging (3 of these were collected from a staked sheep, and therefore do not appear in the trap-collection records). One of the specimens fed by crawling up into the short hair covering the belly, and the remaining seven fed at a tiny bare area where the sheep's belly had been nicked during shearing. A careful examination was always made, but no flies were observed feeding on the various short-haired parts of the head, though this type of feeding might have been expected from laboratory data recorded at Kerrville with released wild flies.

As evident in Table 2, *variipennis* will feed from noon to late evening; but no specimens were taken at temperatures above 90° F., and large numbers occurred only from late afternoon through dusk. Engorgement was more common when the sheep was sheared.

Specimens of *Leptoconops* were observed feeding from late morning to dusk (specimens seen engorging occurred in Collections 17–19, 27–30, and 43). In Collections 19 and 30, they were present in moderate numbers along with the first *variipennis* to appear that day. The occurrence of *Leptoconops* and three species of *Simulium* is indicated in Table 2. *Simulium arcticum* was represented only by one female specimen, which was recovered in a trap-collection on October 9.

TABLE 2.—*Culicoides variipennis* (Coquillett) and some other biting flies recovered from an animal-bait trap operated near Grand Junction, Colorado, September 8–10 and October 5–8, 1960

Collection no.	Date	Time trap closed	Minutes sheep exposed	Temperature (° F.) Shade	Temperature (° F.) Sun	Number of flies collected: *variipennis* Females: Freshly engorged	*variipennis* Females: Not freshly engorged	*variipennis* Males	Females of other species [a]
				Sheep unsheared					
16	Sept. 8	1:20 p.m.	10	..	..	0	0	0	K G
17		1:50	20	88	101	0	0	0	K
18		2:30	20	88	98	0	0	0	K G
19		5:05	20	88	90	0	2	0	K G
20		6:10	30	83	85	0	61	16	V
21		6:40	15	72	(sunset-	2	28	4	K
22		7:05	10	71	6:20)	1	29	1	G
23		7:35	15	70		0	10	2	
24		10:35	10	58		2	8	0	
25	Sept. 9	5:25 a.m.	395	55		0	0	0	
26		11:00	20	79	80	0	0	0	K G
27		11:30	15	..	..	0	0	0	K
28		2:15 p.m.	15	87	92	0	0	0	K
29		5:00	15	88	90	0	0	0	K
30		5:45	30	..	..	1	15	1	K V
31		6:20	10	77	77	0	1	3	G V
32		6:45	15	72	(sunset- [b]	0	13	1	
33		7:10	10	71	6:20) [b]				
34		10:20	15	59		0	1	0	
35	Sept.10	1:45 a.m.	15	50		0	0	0	
36	Oct. 5	3:45 p.m.	15	82	85	0	2	0	V
39		5:35	10	72	75	1	10	0	V
40		6:15	10	64	(sunset-	0	69	11	V
					5:40)				
41	Oct. 6	12:35 p.m.	15	79	80	0	1	0	
42		12:55	10	79	80	0	0	0	
43		4:10	15	79	82	1	4	1	K G
44		4:35	15	78	82	1	11	2	K V P
45		5:00	15	75	79	0	37	7	K G V P
46		5:20	10	69	73	0	32	5	V P
47		5:40	5	67	68	0	38	2	V P
48		6:00	10	66	(sunset-	0	42	5	V
					5:38)				
				Sheep with ventral area sheared					
50	Oct. 7	5:16 p.m.	10	73	73	7	58	11	V P
51		5:45	10	69	(sunset-	4	25	12	V P
					5:25)				
52	Oct. 8	5:45 p.m.	10	65	cloudy	5	10	0	G V P
53		6:10	10	63	cloudy	5	30	1	G V P

[a] K = *Leptoconops kerteszi* Keiffer.
G = *Simulium griseum* Coquillett.
V = " *vittatum* Zetterstedt.
P = " *piperi* Dyar & Shannon.

[b] The catches from Collections 32 and 33 were combined through error.

PARTHENOGENESIS AND AUTOGENY IN *CULICOIDES BERMUDENSIS* WILLIAMS[1]

R. W. WILLIAMS
School of Public Health and Administrative Medicine, Columbia University

Parthenogenesis is a relatively rare phenomenon among biting Diptera. At least two species of blackflies (Simuliidae) (Basrur and Rothfels, 1959; Davies, 1954), three species of mosquitoes (Culicidae) (Kitzmiller, 1959) and several unidentified species of the genera *Dasyhelea* and *Forcipomyia* (Ceratopogonidae) (Downes, 1955) have at times displayed spontaneous ovarian development and it has been noted that possibly at least one batch of eggs of *Culicoides circumscriptus* may have developed parthenogenetically (Becker, 1961).

Autogeny (viable egg production without a blood meal) has been reported in at least 23 species of mosquitoes (Chao, 1958; Lea and Lum, 1959), three species of blackflies (Davies, 1954), two species of *Phlebotomus* (Johnson, 1961), 5 species of *Culicoides,* (Downes, 1958a and Amosova, 1959). Rarely have the two phenomena been reported to occur in the same individuals of a given species. The blackfly, *Prosimulium ursinum,* exhibits both phenomena in Norway but in Alaska and in other areas of its distribution it is bisexual (Davies, 1954). The genus *Dasyhelea* may contain forms which have spontaneous ovarian development and are nonbiting but conclusive evidence of this is lacking at this time (Downes, 1958b).

Culicoides bermudensis was described from Bermuda only from females (Williams, 1956). No males have ever been recovered there either in emergence traps or light traps during three summers of study. In the same year that *C. bermudensis* was found in Bermuda both males and females of what is considered to be the same species, were taken in Walton County, Florida, and from Aransas County, Texas (Beck, 1956; Jones, 1957). The male was described from Florida (Beck, 1956).

During the summer of 1960, it was noted that about 20 percent of the adult females of *C. bermudensis,* taken daily from emergence traps in Bermuda, were visibly gravid when examined under a dissecting microscope while others showed developing eggs, but no external swelling of the abdomen. Some, upon dissection, showed no indication of egg development.

Adults of *C. bermudensis* were reared from larvae to associate the immature stages with the adult. By a modified Bidlingmayer technique (Williams, 1960), larvae were isolated from soils from areas from which only this species of ceratopogonid was recovered in emergence traps. Cultures of these larvae were set up in 10 cm. Stender dishes containing soil from the original habitat and water. As larvae completed their growth they were placed singly in Stender dishes containing only water. Although some mortality occurred, many pupated. There was also some mortality among the pupae. All of the adults which emerged were females. Two lived three days, which in the confines of the half-filled Stender dishes, was long enough to deposit eggs. One deposited 22 eggs, the other 16. All eggs from both batches hatched within 48 hours, some in less than 24. It was thus demonstrated that *C. bermudensis* had developed an obligate thelytoky type of parthenogenesis, in which males are completely absent, that this species is autogenous, and that no form of nourishment, even plant sugars, need be ingested prior to the development and deposition of the first batch of eggs.

[1] Contribution No. 289 of the Bermuda Biological Station. Paper III in a series on "The Biting Midges of the Genus *Culicoides* in the Bermuda Islands (Diptera, Ceratopogonidae)." The 1960 investigations were sponsored by research grant E-3060 from the Public Health Service, National Institutes of Health and funds from the Bermuda Biological Station given by the National Science Foundation.

According to Imms (1957), the significance of the obligate thelytoky type of reproduction ". . . is that it permits more rapid reproduction by allowing all the activity of the female to be concentrated on feeding and the production of young and by eliminating any competition for food which might otherwise have resulted from the presence of males." Since *C. bermudensis* is also autogenous, some other significance must be given to this type of reproduction in this species and in *Prosimulium ursinum*. In the case of *C. bermudensis*, it may be merely a result of the importation of females only, into the Bermuda Islands from North America. As may have happened also with *C. circumscriptus*, a few batches of eggs may have been deposited parthenogenetically, resulting only in females. Some of these, in turn might reproduce in the same manner. Thus the population may have gradually built up to the modest numbers one now finds in the Bermuda Islands.

It would appear that autogeny may have developed after arrival in the Bermudas, for it has been noted that in the Bermuda form of *C. bermudensis*, the number of mandibular teeth vary from four to eight, a reduction from the maximum of 10 which is frequently found in the U. S. form. Perhaps, as has been suggested for certain other autogenous species of *Culicoides*, the normal and related hosts of the adults may be wanting in the Bermudas and the larval habitats offer sufficient protein so that the adult does not require further protein for egg development.

Although Dr. Richard Davenport, to whom the author expresses his thanks, made unsuccessful attempts to determine the basic chromosome number in *C. bermudensis*, it may well be triploid, as found in the unisexual form of the blackfly, *Cnephia mutata*, which lives with but never crosses with the diploid forms which are bisexual (Basrur and Rothfels, 1959).

C. bermudensis is apparently the first known representative of the family Ceratopogonidae to demonstrate complete obligate thelytoky in conjunction with autogeny in nature for many generations and the second such strain or species from an otherwise biting group of Diptera. Of the now known autogenous species of *Culicoides, C. bermudensis* is the only one reported from a subtropical area, the rest being found in northern regions.

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THE INTERNAL REPRODUCTIVE ANATOMY OF STERILE MALE *AEDES AEGYPTI* (LINNAEUS) [1]

JACK COLVARD JONES
Department of Entomology, University of Maryland, College Park, Maryland

In the course of studies on the morphology of the reproductive system of *Aedes aegypti* (Linnaeus) (Bangkok strain; reared in this laboratory since 1959) in which numerous male adults were being dissected, three sterile males were encountered. One of the sterile males had been kept with an excess of females, the other two had been kept only with other males.

The terminalia of all sterile males had rotated at the time of dissection. All three were dissected in Ephrussi-Beadle saline (Ephrussi and Beadle, 1936), and notes were made on the living systems after which they were fixed in formalin-acetic acid-ethanol, then treated with 90, 70, and 50 percent ethanol, and washed in distilled water. Two reproductive systems were mounted unstained, and one was stained with Mayer's acid hemalum for 30 seconds before mounting in glycerine.

The testes of the sterile males (Fig. 1, T) were about one-half the length and about one-fourth the width of those removed from non-sterile males reared in the same batch (Fig. 2). One testis was smaller than the other in the same male, a condition also found among normal males. The testes of the sterile males were essentially colorless with both direct and transmitted light, possessed only a few, poorly defined, small testicular compartments, and were entirely devoid of germinal cells. Nuclei were clearly evident in the testicular sheath. Normally the testes of both mated and unmated adult males contain 15 to 20 or more testicular compartments filled with numerous germinal cells in various degrees of development, and, with direct illumination the lower half of the testes appears

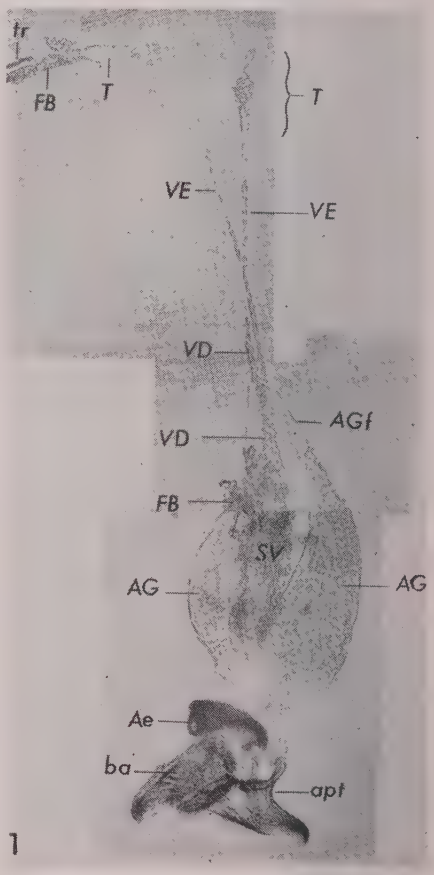

FIG. 1.—Unstained whole mount of reproductive system of a sterile adult male *Aedes aegypti* (Linnaeus) (Bangkok strain) showing testes (T) with fragment of testicular fat body (FB, in upper left hand corner) and tracheal branch (tr), vasa efferentia (VE), vasa deferentia (VD), and accessory glands (AG) and their filaments (AGf). The seminal vesicles (SV) are largely obscured by dense fat body (FB), the aedeagus (Ae) is displaced. The apical paraproct is shown at *apt*, and a portion of the basimere at *ba*.

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whitish; with transmitted light it has a distinct brownish cast. In whole mounts of the testicular sheath of normal males nuclei are generally seen only with difficulty. In sterile males, the vasa efferentia (Fig. 1, VE), vasa deferentia (Fig. 1, VD), and seminal vesicles (Fig. 1, SV) were also colorless and devoid of spermatozoa. The vasa efferentia were smaller in diameter than those of normal males. The vas to the smaller testis was somewhat shorter than the other vas, a condition found also in normal males. Fat bodies on the seminal vesicles (Fig. 1, FB) seemed to be more abundant than in normal males. In two of the sterile males one of the accessory glands was considerably larger than the other (Fig. 1, AG), a condition never seen in normal males whether mated or unmated. The accessory glands in two of the sterile males contained little secretory material (i.e., they did not have a large anterior opaque and dense zone and a clearer, less dense posterior zone). In the third sterile male, however, the accessory glands were entirely normal in appearance, size, and shape. The external genitalia of the sterile males did not appear obviously abnormal.

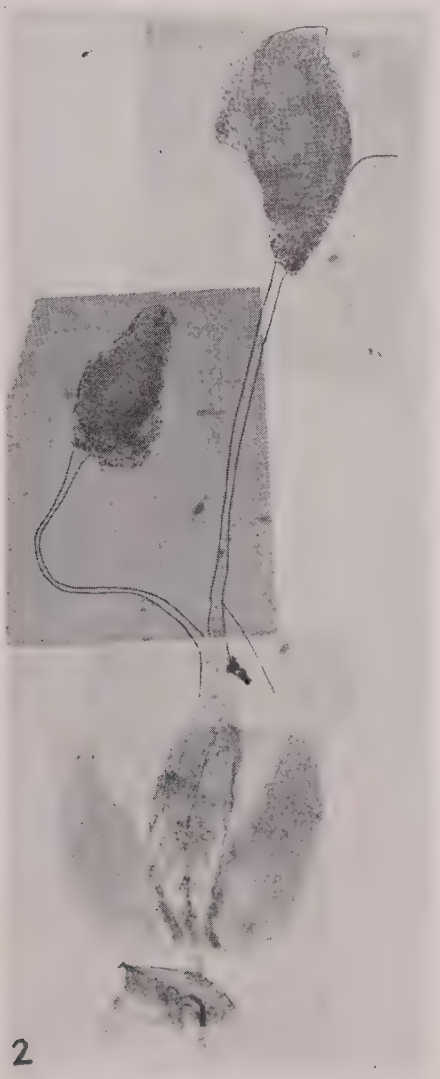

Fig. 2.—Unstained whole mount of reproductive system of a normal adult male *Aedes aegypti* (Linnaeus) (Bangkok strain).

The present findings on sterile male *Aedes aegypti* reveal several interesting facts about the reproductive system: (1) rotation of the terminalium is entirely independent of the presence of germinal cells, (2) abnormalties of one portion of the male reproductive system are not necessarily associated with abnormalities in another portion of the system, (3) the absence of germinal cells from the testis, while having no effect on the general shape of the gonad, is clearly associated with a marked reduction in the size of the gonad and with a very striking decrease in the number of testicular compartments, and (4) the presence of a few testicular compartment in gonads devoid of all germinal cells suggests that the compartments are produced by the testis itself.

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THE *CULICOIDES* OF THE INTERNATIONAL AIRPORT, ISLA VERDE, PUERTO RICO, AS SHOWN BY LIGHT TRAPS [1]

IRVING FOX AND ILEANA GARCÍA-MOLL
School of Medicine-School of Tropical Medicine, University of Puerto Rico, San Juan, P. R.

The Puerto Rico International Airport is in a region of great natural beauty which includes popular centers, hotels and restaurants, and undeveloped areas where a number of other recreational projects are planned. Many acres of swamps occur in the vicinity with extensive breeding of *Culicoides,* and tourists often suffer severe reactions from the bites of *furens,* the most important pest species (Arèan and Fox, 1955; Fox and Berman, 1960). Except for occasional use of thermal aerosols and DDT residual spraying of buildings, no control measures are applied. Very little money is available for the exclusive study of the problem; however, through the combined efforts of several interested agencies, including the U. S. Public Health Service, Puerto Rico Department of Health and the Puerto Rico Ports Authority, it has been possible to operate several light traps for five years. Our objectives were as follows: To find out what species occur and their relative abundance; to ascertain the seasonal variation of *furens* and relate it to climatic conditions; and to obtain population data for gauging the effectiveness of any future control measures.

The light traps were operated from January 1, 1956 through December 31, 1960 in eight localities (Fig. 2), of which six were the same as in a previous report, on mosquitoes (Fox, 1958). However, in 1958 the Lt. 5 locality (Water Tank, Airport proper) and the Lt. 2 locality (Maintenance Area) were eliminated and other places selected, namely, Lt. 7, designated National Guard, being in the Air National Guard area; and Lt. 8, designated New Maintenance for it was not far from the former locality. The numbers of trap nights during each month in 1956 and 1957 were the same as previously published (Fox, 1958). In 1958, 1959 and 1960 there were comparable figures for the operation. In a total of 7,672 trap-nights five of the nine species known from Puerto Rico (Fox, 1955) were attracted to the traps, and of the total of 499,986 specimens, about 90 percent or 448,547 were *C. furens* (Poey). Next in order of abundance were *insignis* Lutz with 44,169 specimens, *pusillus* Lutz with 6,345, *foxi* Ortiz with 781 and *phlebotomus* (Williston) with only 144. Both 1955 and 1956 were years of heavy tropical storms nine of which reached hurricane intensity in 1955 and three in 1956, with accompanying heavy rainfall and tidal disturbances. These climatic phenomena seemed to have affected *Culicoides* production making 1956 by far the year of greatest *furens* abundance with almost half the total number collected during the five year period even though there were fewest trap-nights. The relative abundance of the four most common species was the same each year as shown in Figure 1. Clearly there was no relationship between the total number of specimens of *furens* collected in all light traps and the total number of inches of rainfall annually; thus, more specimens were collected in 1957 with only 53.01 inches of rainfall than in 1958 with 74.08 inches or 1960 with 64.37 inches. However, *insignis* did show a tendency on an annual basis to increase or decrease in abundance with the total yearly rainfall. When the yearly average per trap-night of three light traps, Lt. 1, Lt. 3, and Lt. 4 which were operated for

[1] This investigation was supported in part by the Puerto Rico Department of Health and in part by Research Grant E-1225, National Institute of Allergy and Infectious Diseases, U. S. Public Health Service. Medical students with summer fellowships under Graduate Training Grant 2E-15 to the senior author from the latter source also participated in some of the work.

the entire five years, are compared with the annual rainfall, *furens* again shows no relationship and *insignis* indicates some relationship (Fig. 3). Not one of the light traps when considered separately showed any connection between the yearly average per trap-night of *furens* and the annual rainfall (Table 1).

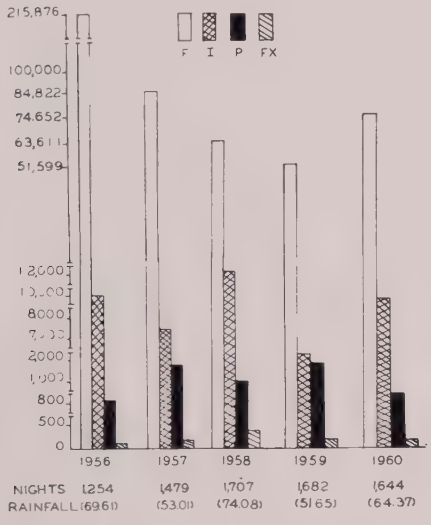

FIG. 1.—The relative abundance of *Culicoides furens, insignis, pusillus,* and *foxi* as shown by the total number of specimens from all light traps 1956–1960, with the trap-nights and rainfall in inches for each year.

The monthly averages per trap-night of all the light traps together indicated that the period of greatest abundance of *furens* is in general from February through June, but in the unusual year 1956 this period extended through October. In the season of greatest abundance, the total monthly average per trap-night was usually between 75 and 100, while in the season of least abundance such as November, December, and January it was about 25 or less. The months with an average of about 50 per trap-night were as follows: In 1956, February through October; 1957, March through June, and also September; 1958, March through June; 1959, June only; 1960, April through June and also September. No relationship to the monthly rainfall in inches could be found, for example in April, 1956 the average per trap-night of five light traps was 758.5 and the April rainfall 4.54 inches, but in May the average was 73.2 and the rainfall was 9.66 inches. In 1957 the peaks of *furens* abundance

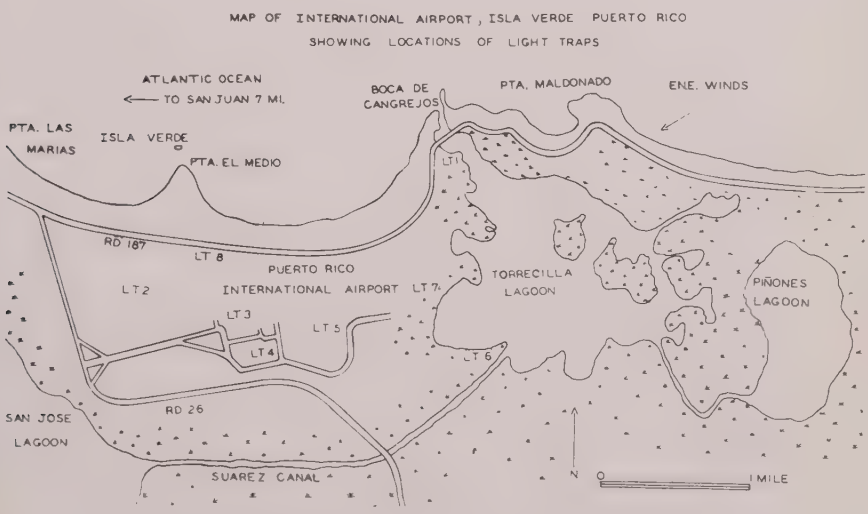

FIG. 2.—Map indicating the location of each light trap.

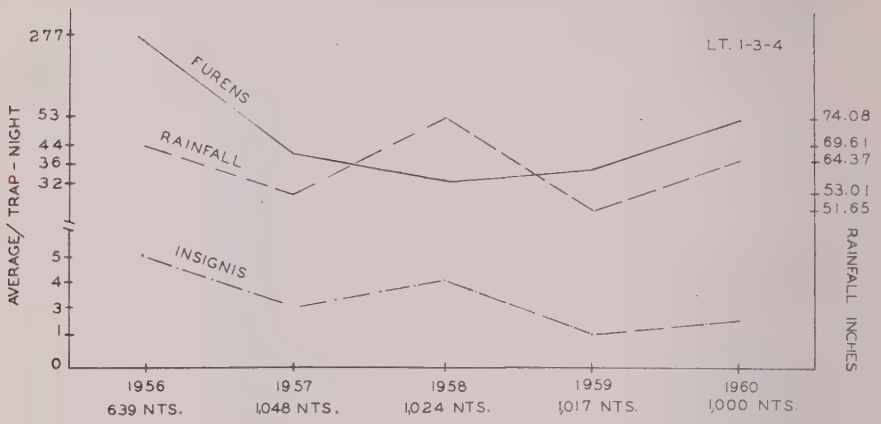

FIG. 3.—*C. furens* and *insignis*, the yearly average per light trap-night of the total of Lt. 1, Lt. 3, and Lt. 4 compared with the rainfall.

were in March (96.8 specimens per trap-night) and April (86.4 specimens), but the rainfall was very low during these months, 1.51 and 1.14 inches respectively. Similar results were obtained in 1958 and 1960; and it was not possible to relate the monthly light trap counts to either the dry or wet periods of the years of study in a consistent way (Fig. 4 and 5).

Counts from each of the light traps which were run more or less regularly were analyzed on a weekly basis, with the results shown in Figures 7, 8, 9, 10 and 11. The yield differed greatly among the different light-traps; for example Lt. 4 and Lt. 8 consistently were very low and Lt. 1 and Lt. 7 very high indicating the importance of the locations of the traps. Since these two traps were nearest the Torrecilla Lagoon, it is likely that the more extensive breeding places were there (Fig. 12). Although trends were clearly evident, a light-trap could show considerable variation from week to week; thus in May and June, 1960, Lt. 1 yielded 10 and more times as many specimens in some weeks as in others, proving the necessity for continuous nightly operation throughout the year. No consistent relationship between the weekly average per trap-night and the weekly rainfall in inches could be found.

At San Juan, Puerto Rico there is a daily low and high tide in the period from 12 midnight to 12 noon and also a low and a high tide in the post meridian period. The daily variation in the height of the tide is between one and two feet and there is also a seasonal variation. To obtain the average monthly predicted height of the high tides in feet,

TABLE 1.—Yearly average per light trap-night, with the yearly rainfall in inches shown in parenthesis

	1956 (69.61)	1957 (53.01)	1958 (74.08)	1959 (51.65)	1960 (64.37)
Lt. 1	531.4	106.6	39.2	83.8	153.3
Lt. 2	53.9	56.8	..	..	..
Lt. 3	49.4	21.2	50.7	22.2	14.0
Lt. 4	18.5	7.3	3.2	3.0	2.0
Lt. 5	8.9	5.7	..	..	..
Lt. 7	..	..	88.2	40.8	59.7
Lt. 8	..	..	7.6	7.1	4.7

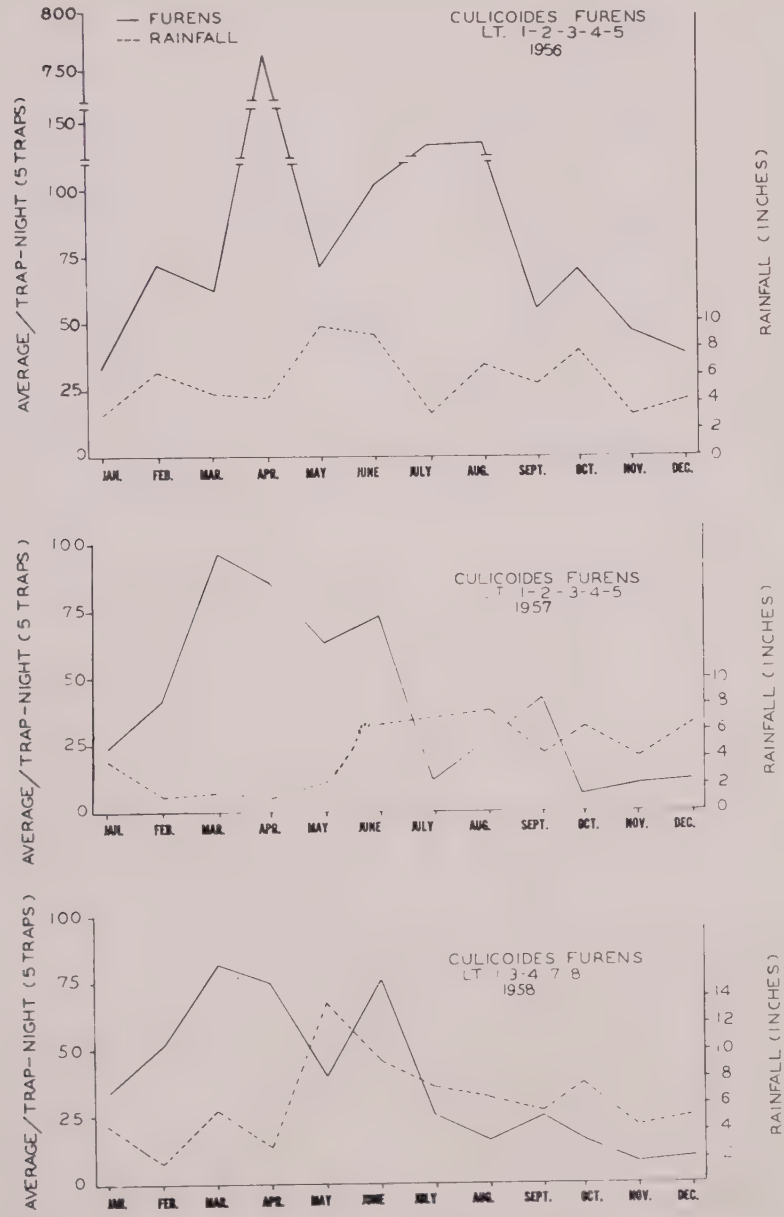

FIG. 4.—*C. furens,* monthly average per light trap-night of the total of Lt. 1, Lt. 2, Lt. 3, Lt. 4, and Lt. 5, for 1956 and 1957, and the total of Lt. 1, Lt. 3, Lt. 4, Lt. 7, and Lt. 8 for 1958 compared with the monthly rainfall.

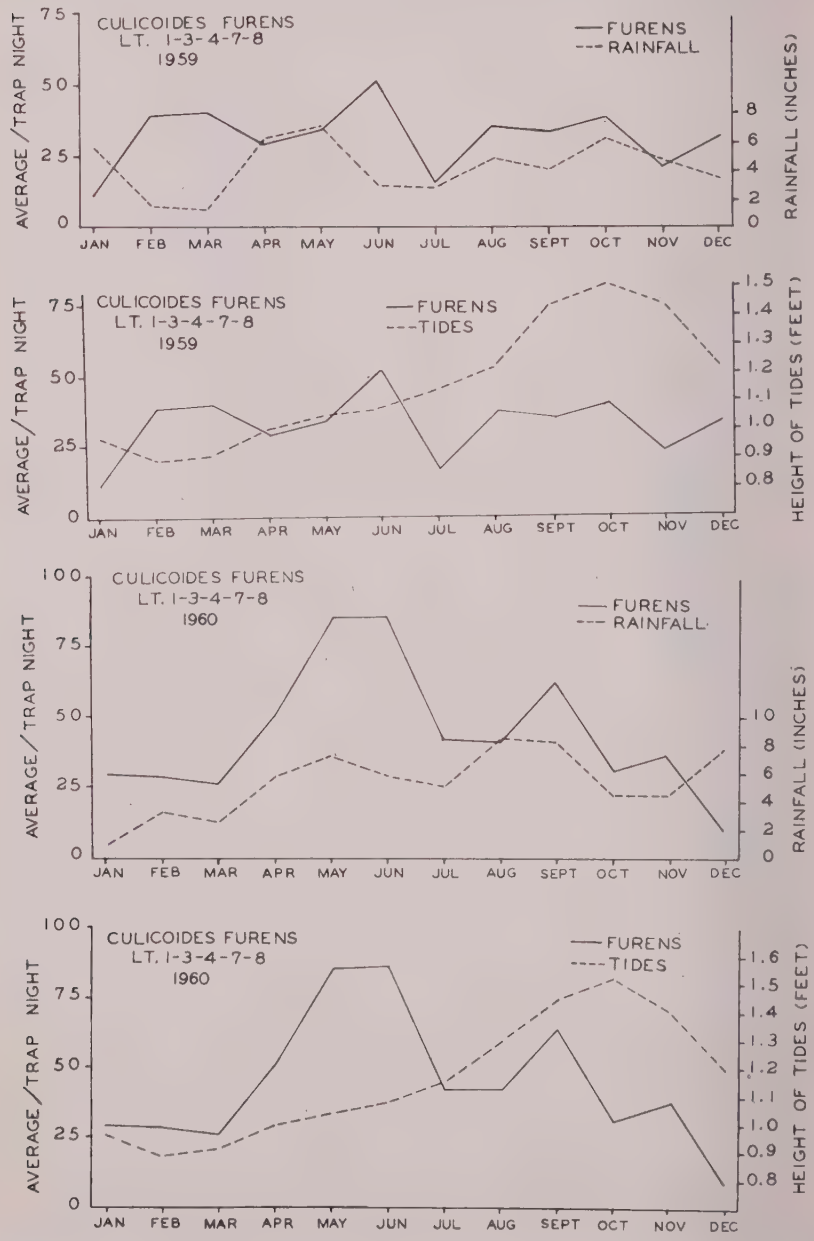

FIG. 5.—*C. furens,* monthly average per trap-night of the total of five traps compared with the monthly rainfall in inches and the monthly average predicted height of high tides in feet for 1959 and 1960.

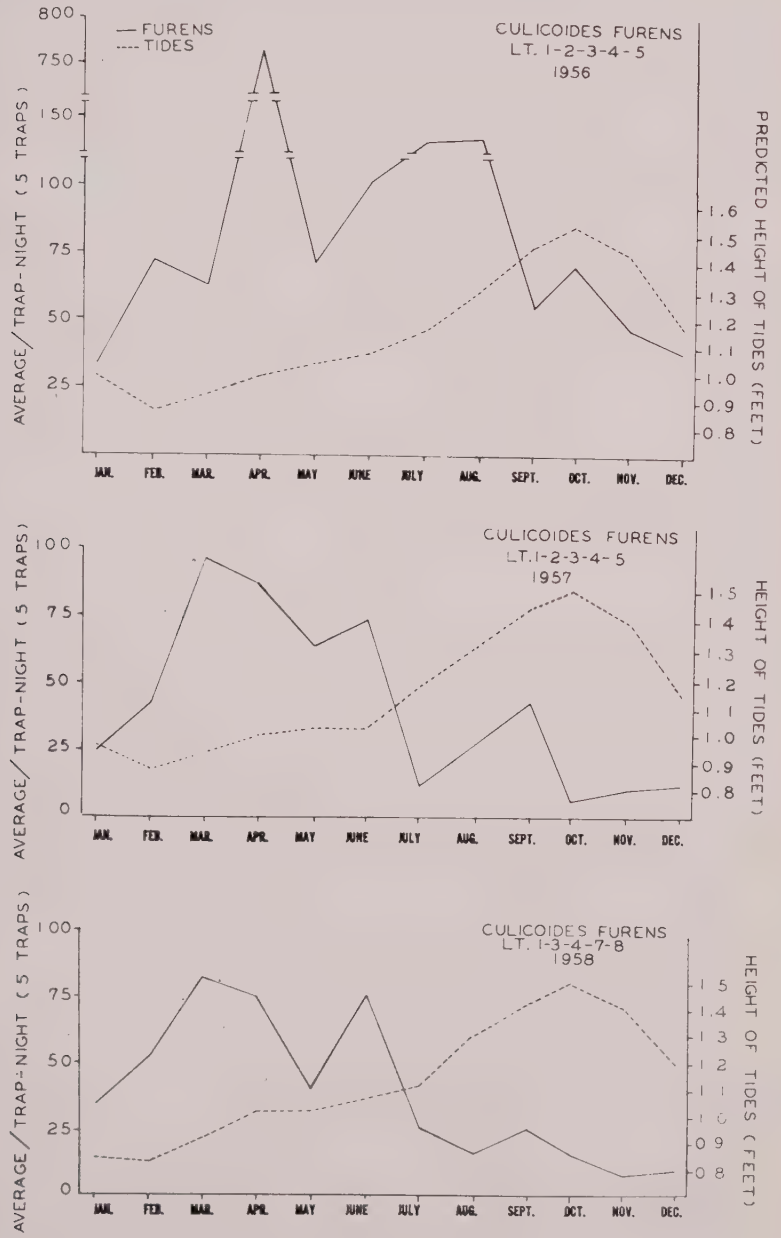

FIG. 6.—*C. furens*, monthly average per trap-night of the total of five light traps compared with the monthly average predicted height of high tides for 1956, 1957, and 1958.

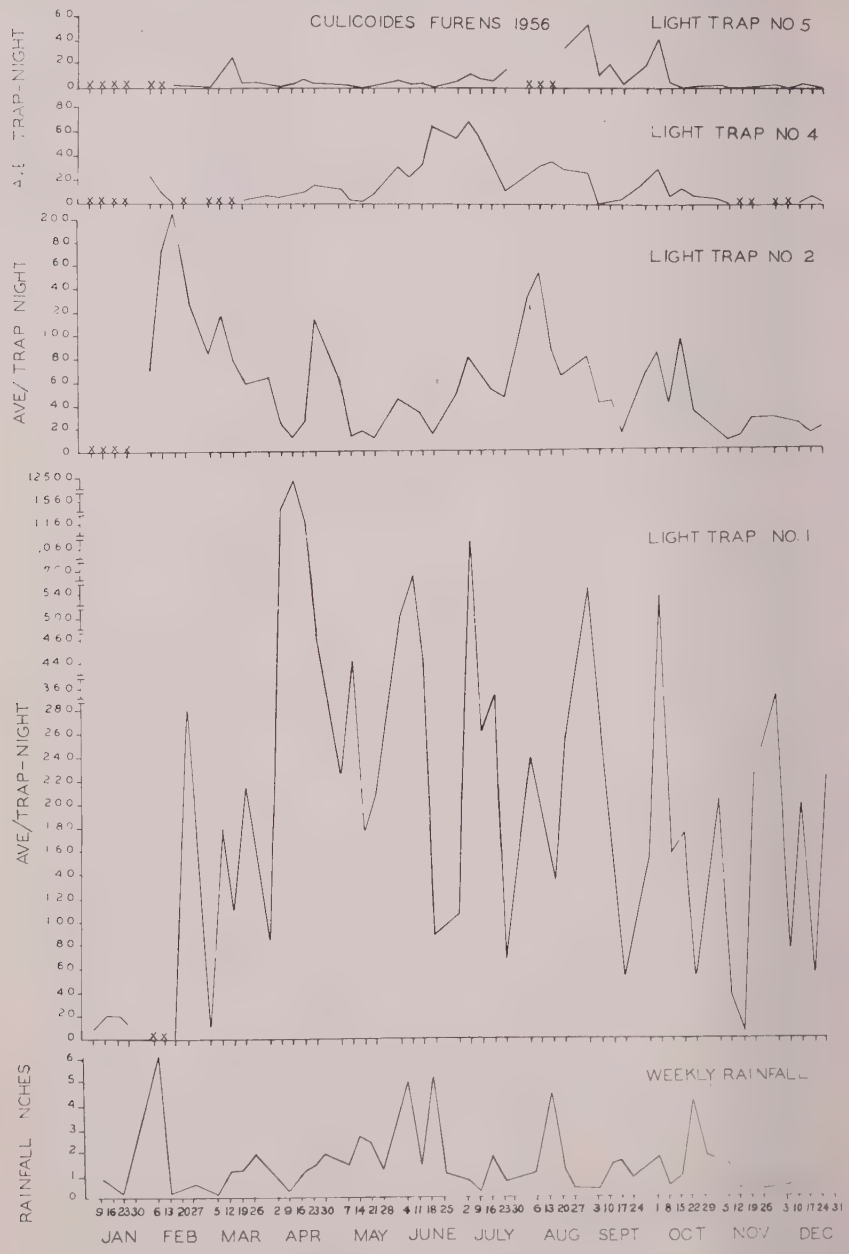
CULICOIDES FURENS 1956
LIGHT TRAP NO 5
LIGHT TRAP NO 4
LIGHT TRAP NO 2
LIGHT TRAP NO 1
WEEKLY RAINFALL
AVE/TRAP-NIGHT
RAINFALL INCHES
JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV DEC

FIG. 7.—Weekly average per trap-night of *C. furens* for each of four light traps (the letter "x" indicates that the light trap did not operate) compared with the weekly rainfall in inches in 1956.

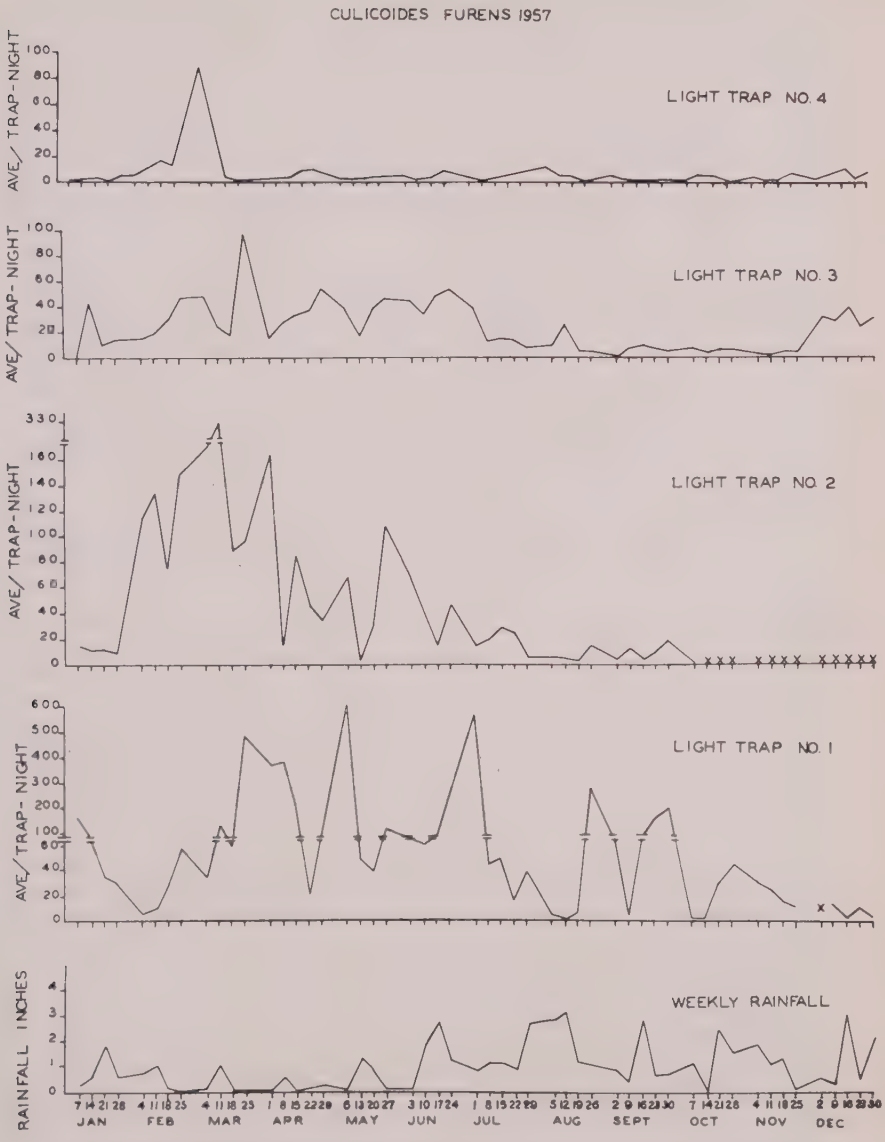

FIG. 8.—Weekly average per light trap-night of *C. furens* and the weekly rainfall in 1957.

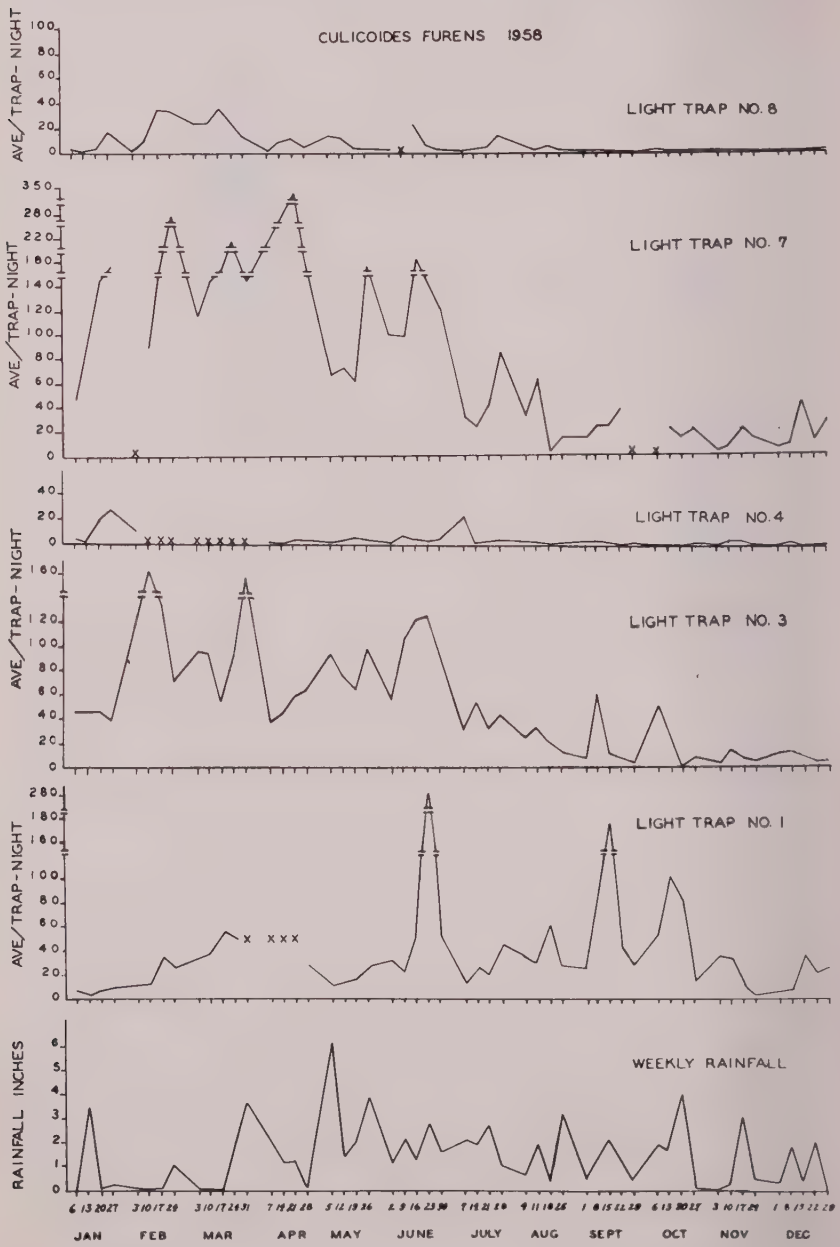

FIG. 9.—Weekly average per light trap-night of *C. furens* and the weekly rainfall in 1958.

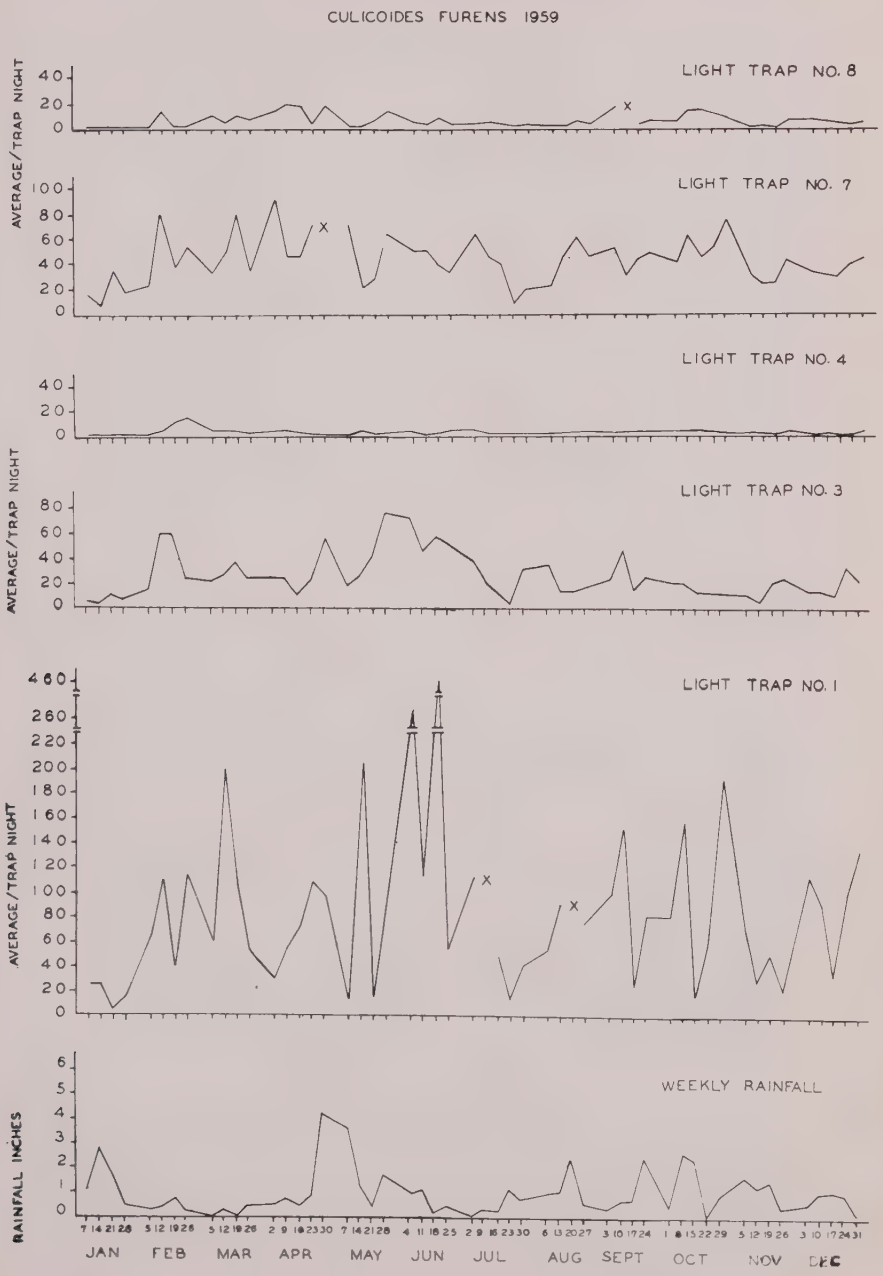
CULICOIDES FURENS 1959
LIGHT TRAP NO. 8
LIGHT TRAP NO. 7
LIGHT TRAP NO. 4
LIGHT TRAP NO. 3
LIGHT TRAP NO. 1
AVERAGE/TRAP NIGHT
WEEKLY RAINFALL
RAINFALL INCHES
JAN FEB MAR APR MAY JUN JUL AUG SEPT OCT NOV DEC

FIG. 10.—Weekly average per light trap-night of *C. furens* and the weekly rainfall in 1959.

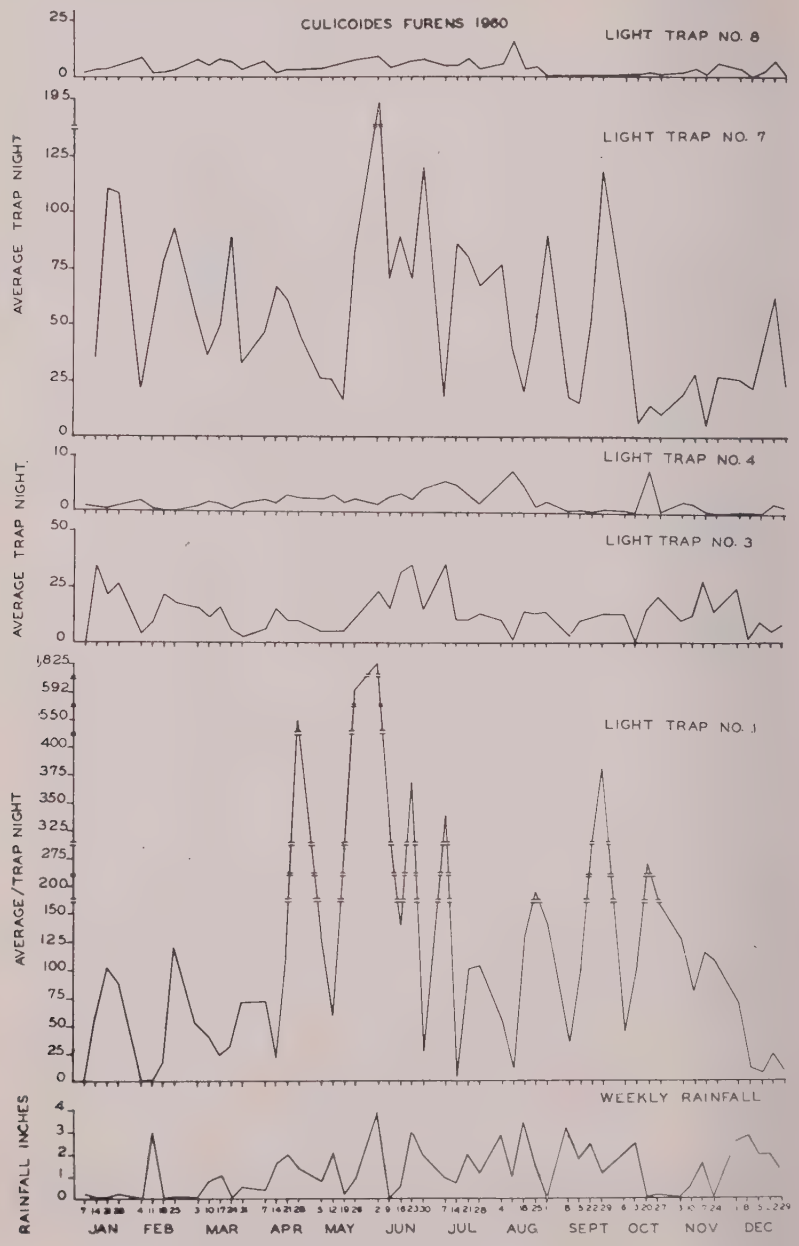
CULICOIDES FURENS 1960
LIGHT TRAP NO. 8
LIGHT TRAP NO. 7
LIGHT TRAP NO. 4
LIGHT TRAP NO. 3
LIGHT TRAP NO. 1
AVERAGE TRAP NIGHT
AVERAGE/TRAP NIGHT
WEEKLY RAINFALL
RAINFALL INCHES
JAN FEB MAR APR MAY JUN JUL AUG SEPT OCT NOV DEC

FIG. 11.—Weekly average per light trap-night of *C. furens* and the weekly rainfall in 1960.

Fig. 12.—Bridge at the entrance to Torrecilla Lagoon from the Atlantic Ocean, Boca de Cangrejos, Puerto Rico, February 20, 1961. B. Torrecilla Lagoon with arrow indicating the location of Light Trap No. 1 at the Boca de Cangrejos Yacht Club, February 20, 1961. C. Light Trap No. 1, Boca de Cangrejos Yacht Club, February 17, 1961. D. Dense foliage of the mangrove marsh which borders Torrecilla Lagoon, Boca de Cangrejos where adult *Culicoides furens* (Poey) abound, February 20, 1961. E. Location of light traps in relation to the Main Building, International Airport, Isla Verde, Puerto Rico, February 17, 1961. F. Light Trap No. 3, Terminal, International Airport, Isla Verde, Puerto Rico, February 17, 1961. G. Light Trap No. 4, Transformer, International Airport, Isla Verde, Puerto Rico, February 17, 1961. H. Light Trap No. 7, Air National Guard, International Airport, Isla Verde, Puerto Rico, February 17, 1961. (Photographs by Miss Ileana Garcia-Moll, except for D.)

the two high tides of each day as given in Tide Tables (U. S. Department of Commerce, 1955) are averaged and the total sum of the averages are divided by the number of days in the month. Figures 5 and 6 show a relationship more or less consistent from year to year between the monthly average per trap-night of *furens* and the monthly average predicted height of the high tides. The months of lower tides are the months of greatest abundance of *furens,* and during the months of higher tides there are considerably fewer specimens in the light traps. Studies made by Forattini *et al.* (1958) indicate that a Brazilian salt marsh species, *C. marium* Lutz is also abundant at periods of low tides. Analysis of the individual light trap counts on a weekly basis showed that certain light traps yielded much fewer than others and a single light trap would vary considerably from week to week, hence it is necessary to place them advantageously and operate them continuously. In conclusion, the data obtained indicate that light traps are a valuable adjunct for finding out seasonal variation of *C. furens* and for providing population data necessary to gauge control effectiveness. However, it is necessary to check these data by other methods of determining population density such as human biting counts, animal bait traps, and extracting larvae from the soil.

ACKNOWLEDGMENTS

Thanks are expressed to Dr. Pablo Morales Otero of the Puerto Rico Legislature for continuous encouragement; Mr. Manuel Pérez Torres, Puerto Rico Department of Public Health, Dr. Marvin S. Cashion, U. S. Public Health Service and Mr. David Smedley, U. S. Weather Bureau for their cooperation; Mr. Francisco Romero and Mr. Rafael Alemán for technical assistance. Mr. Salomón A. Monserrate, Mr. José F. Pascual, and Mr. Héctor L. Delgado-Osorio, summer medical student fellows under U.S.P.H.S. Graduate Research Training Grant 2E-15 also collaborated in certain aspects of the work.

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Charges were made for extra pages in this paper.

Be making your plans now to attend the AMCA Annual Meeting in Galveston, Texas, March 5, 6, 7, 1962. Texas organized on a statewide scale during the past year, and an outstanding conference is assured. Details will appear in the September and December numbers of *Mosquito News.*

THE EFFECTS OF THE QUALITY OF BLOOD AND TEMPERATURE ON THE PRODUCTION AND VIABILITY OF EGGS IN *CULEX QUINQUEFASCIATUS*

HELEN B. JORDAN
Georgia State College, Atlanta *

In maintaining a colony of *Culex quinquefasciatus,* various animals on hand in the laboratory at the time furnished blood for the females. Since there were noticeable variations in the size of egg rafts, depending on the blood source, some simple feeding experiments were designed and carried out (1) to measure the effects of the quality of various bloods on the production and viability of eggs, and (2) to measure the effect of temperature on the number of eggs laid. Certain host preferences indicated in this paper may add to the scant information concerning the natural feeding habits of *C. quinquefasciatus.*

The following animals were used as a source of blood: the Eastern fence lizard (*Sceloporus undulatus* (Latreille), the anole (*Anolis carolinensis* Voigt), the hognosed snake (*Heterodon platyrhinos* Latreille), the common kingsnake (*Lampropeltis getulus* Linnaeus), a boa (*Constrictor constrictor*), Tennessee brown bats (*Myotis grisescens* Howell), the opossum (*Didelphis marsupialis* Linnaeus), and the domestic chicken (*Gallus domesticus*).

METHODS. Because of the nature of the animals employed in these experiments, it was impossible to keep methods of exposure to mosquitoes uniform. The natural habits and habitat of certain animals make it impractical to apply standard methods of procedure in exposing them to mosquitoes for a blood meal. The simple practice of immobilizing chickens and feeding mosquitoes on them from lantern globes was used for this host. However, this method was impractical for small, infrequently handled animals such as bats and lizards. Although lizards and bats will hang perfectly still on the wall of cloth cages for hours, they resist being immobilized artifically; therefore they were turned loose in the colony cage (capacity: about 8 cubic feet). On the other hand, larger animals such as the opossum and snakes were confined to hardware-cloth cages placed inside the colony cage permitting the free movement of mosquitoes in and out of the cage containing the animals furnishing the blood meal.

After feeding on various animals, fully engorged femlaes were removed singly by suction tube, placed at the desired temperature and allowed to oviposit. Egg rafts were floated onto a piece of filter paper and the eggs counted under a dissecting microscope. To ascertain viability of the eggs, individual rafts were placed in separate dishes and the resulting larvae counted. In experiments designed to measure the effect of temperature, two comparable batches were made up by random selection as the engorged females were separated from the feeding cage and one batch placed at 28° C., the other at 16° C. No consideration was given to the amount of blood ingested, since much of it is habitually extruded a few hours after the blood meal is taken. All females fed to repletion. After the blood meal, all mosquitoes were fed on preserved raisins.

EXPERIMENTAL RESULTS AND DISCUSSION. Although autogeny is known to exist among mosquitoes, the vast majority of them require some sort of blood for the development of viable eggs, and the number of eggs laid seems to vary according to the blood source. Production of eggs seems to be dependent upon the nature and concentration of blood proteins. Greenberg (1951) found that *Aëdes aegypti* laid 16 times as many eggs when fed de-fibrinated sheep blood as when fed

* Study aided by National Science Foundation Research Grant G2486.

washed sheep red blood cells. Several proteins and protein products increased oviposition in mosquitoes fed on sheep red blood cells. Detailed quantitative studies on the effect of blood and blood fraction on the production of eggs by *A. aegypti* have been made by Woke (1937a; 1937). Following ingestion of blood from man and rhesus monkeys, *A. aegypti* produced significantly fewer eggs than after feeding on canaries, rabbits, guinea pigs, turtles, or frogs. Roy (1931) reported that *Anopheles stephensi* produced considerably fewer eggs when fed on man than when fed on rats, rabbits and guinea pigs. Similar differences have been noted by Roubaud and Mezger (1934) and by Tate and Vincent (1936) for *Culex pipiens*.

Figure 1, Section A, shows the average number of eggs produced by *C. quinque-*

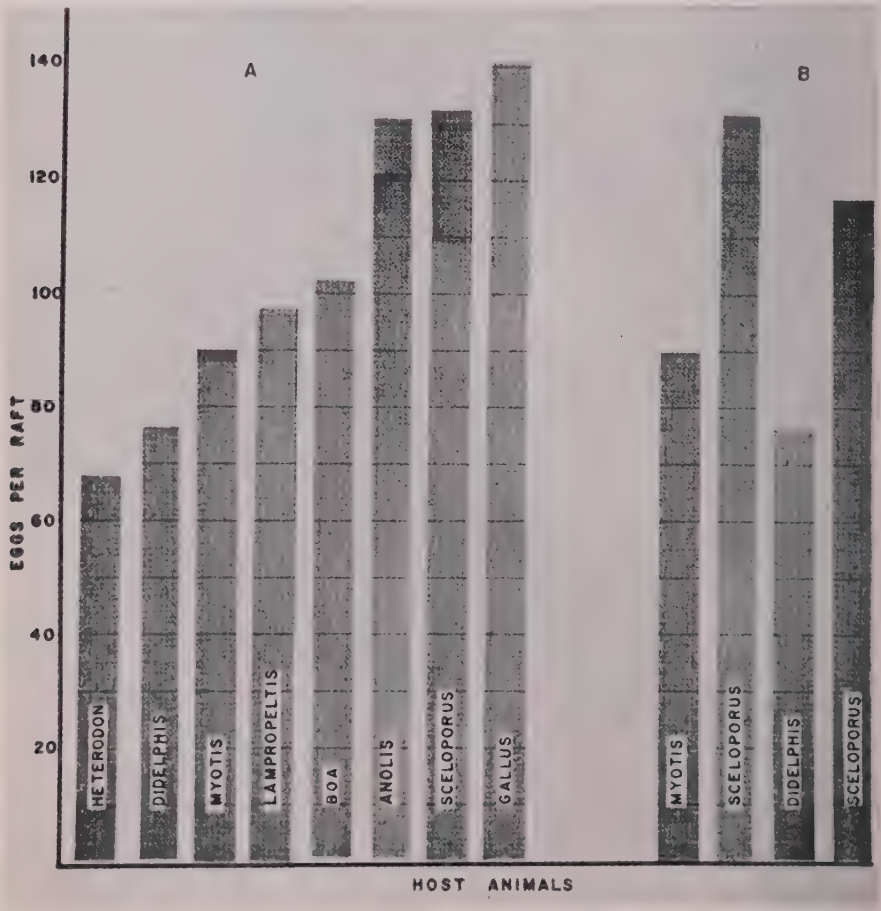

FIG. 1.—A—Effects of various vertebrate bloods on the production of eggs in *Culex quinquefasciatus*. The number of egg-rafts counted to obtain averages: *Heterodon*—25; *Didelphis*—65; *Myotis*—86; *Lampropeltis*—150; boa (*C. constrictor*)—90; *Anolis*—51; *Sceloporus*—174; Gallus—66.

B—Batches of mosquitoes initially fed on bats (*Myotis*) and opossum (*Didelphis*) were allowed to re-feed on lizards (*Sceloporus*). Egg-nutrient blood variable is indicated by the number of eggs resulting from lizard blood. All mosquitoes were stored at 28° C.

fasciatus when fed on various animals, and kept at 28° C.; Section B of the same figure shows the difference in the number of eggs laid by the same lot of mosquitoes when they re-fed on a different animal. Mosquitoes previously fed on bats and kept at 28° C., re-fed on a lizard about three weeks later and kept at the same temperature, produced an average of 132 eggs per raft (40 rafts used in computing average) as compared to an average of 90 resulting from the initial blood meal on bats, or a difference of 42 eggs per raft (86 rafts used in computing the average). Similarly, mosquitoes previously fed on an opossum were re-fed on a lizard, and produced 117 eggs per raft (30 rafts used in computing average) as compared to 79 resulting from the opossum blood meal, or an increase of 38 eggs per raft (65 rafts used in computing average). Mosquitoes previously fed on a kingsnake and kept at 28° C. were re-fed on a lizard. An average of 116 eggs per raft (50 rafts used in computing average) was obtained from lizard blood as compared to 98 from the kingsnake (150 rafts used in computing average). Although the effect of aging was not designed to be a part of this experiment, it seems that it has little or no effect on oviposition of this mosquito. In all three re-feeding experiments, mosquitoes feeding on *Sceloporus* (from two to three weeks after the initial blood meals from other animals) produced significantly larger numbers of eggs than when they took the first blood meal from another animal.

Culex quinquefasciatus fed on both cold and warm-blooded animals, but some host preference was indicated in both groups of vertebrates. They fed more freely on the boa and the kingsnake than on the hognose snake. A snapping turtle, frogs (*Rana pipiens*) and white rats were exposed to them under the same conditions under which they fed very well on the other animals. Only six mosquitoes fed on the turtle, and none at all fed on the frogs and white rats, although these animals were exposed to them several times.

Regardless of the source of blood ingested, eggs were laid during the third day after feeding if kept at 28° C., and during the sixth day if kept at 16° C. Although there is an apparent decrease of about five eggs per raft when mosquitoes were kept at the lower temperature, as Table 1 shows, the mean differences are insignificant according to t-test analysis. Fewer females laid eggs at the lower temperature. All of the eggs resulting from chicken blood hatched, while those produced from reptile and mammal blood were only 96 percent viable.

TABLE 1.—The effect of temperature on the number of eggs produced by *Culex quinquefasciatus*

Host animal	Temperature	Average no. of eggs per raft	Range
Bats (*Myotis grisescens*)	28° C.	90(86)*	25–182
	16° C.	84(50)	30–184
Boa (*Constrictor constrictor*)	28° C.	103(90)	30–192
	16° C.	98(81)	56–181
Opossum (*Didelphis marsupialis*)	28° C.	79(65)	38–122
	16° C.	74(58)	40–154

* Figures in parentheses indicate the number of egg-rafts used to make up averages.

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ADDITIONAL RECORDS AND OBSERVATIONS ON NEVADA MOSQUITOES

H. C. CHAPMAN
Entomology Research Division, Agric. Res. Serv., U.S.D.A.[1]

The mosquito fauna of Nevada was recently reported to contain 29 species, including five new State records (Chapman 1959). In this report, the writer stated that Dyar's (1922) record from Steamboat Springs of *Anopheles maculipennis* Meigen with brassy wingtips as *A. earlei* Vargas, which was in error since the specimens were undoubtedly *A. freeborni* Aitken. *A. earlei* has not as yet been collected in Nevada.

Recent larval collections of *Culex apicalis* Adams and *Psorophora confinnis* (Lynch-Arribalzaga) bring the number of species known from the State to 30. Localities, dates, and ecological notes are herein included for these species as well as for *Aedes sierrensis* (Ludlow) and *Uranotaenia anhydor* Dyar, which were collected as larvae for the first time in the State.

Culex apicalis Adams

This species was listed by Carpenter and LaCasse (1955) from Arizona, California, and Mexico, by Nielsen and Rees (1959) from Utah, and from Texas by Breland (1956). It is commonly found in California in woodland pools and never occurs at elevations above 5,000 feet, according to Freeborn and Bohart (1951).

Larvae were collected in Nevada in many areas at elevations ranging from 4,700 to 6,400 feet. Larval habitats were open and shaded pools, streams, and a roadside ditch, all of which contained water emanating from fresh-water springs. Companion species at higher elevations were *Culiseta incidens* (Thomson) and *Eucorethra underwoodi* Underwood. *Culiseta incidens, C. inornata* (Williston), *Culex peus* Speiser, and *C. boharti* Brookman and Reeves were noted with *C. apicalis* at lower elevations.

Another species of the subgenus *Neoculex, C. territans* Walker, was common in open permanent ponds in the vicinity of Lake Tahoe in several counties but was never noted breeding with *C. apicalis.*

Collection Data:

Douglas County: Glenbrook, VIII-6-59, 6,400 feet; Stateline, VIII-6-59, 6,300 feet.

Lyon County: Silver City, VIII-26-59, 5,000 feet; X-13-59; IX-12-59, 4,700 feet; Dayton, larvae, XI-17-60, 4,500 feet.

Washoe County: Mt. Rose, IX-10-59, 5,500 to 6,000 feet.

Psorophora confinnis Lynch Arribalzaga

This species is known from 33 States (Carpenter and LaCasse, 1955) and is found in the East, South, Midwest, and in the West. Richards *et al.* (1956) reported it from many counties in adjacent Arizona, and Bohart and Freeborn (1951) noted it from two counties in the southeastern corner of California. It is a notorious biting pest in many irrigated areas throughout the country.

Many third- and fourth-instar larvae were collected in several drain ditches adjacent to an alfalfa field just north of Moapa in Clark County. Associated species were *Aedes dorsalis* (Meigen) and *A. vexans* (Meigen). No adults of *P. confinnis* were observed. Male and female *P. confinnis* adults were reared from these larvae as an identification check. This is the first record of the occurrence of this genus in Nevada.

Collection Data:

Clark County: Moapa, larvae, VII-21-60.

Aedes sierrensis (Ludlow)

The only records of this species in the State were adult collections by Dyar (1922) and Richards *et al.* (1956). Both

[1] In cooperation with the Nevada Agricultural Experiment Station, Reno, Nevada.

of these adult collections were made in or adjacent to the Sierra Nevada Mountains where its presence is probably restricted owing to climatological and ecological factors.

The writer first noted second-instar larvae of *A. sierrensis* in a treehole in quaking aspen (*Populus tremuloides* (Michx.) in the Sierra Nevada Mountains in April at 7,500 feet. Both this treehole and one in black cottonwood (*Populus trichocarpa* T. and G.) in the Sierras at 6,500 feet yielded many first-instar larvae within 15 minutes after the holes were flooded by the writer with water from an adjacent stream. According to Peyton (1956), *A. sierrensis* larvae have never been recorded breeding in quaking aspen or above 7,200 feet. Biting adults were observed in a shaded forest in July and September in the Lake Tahoe area.

Although this species is multivoltine in most States, it apparently is both rare and usually univoltine in Nevada because of the paucity of precipitation (except snow) and hardwood host trees with suitable treeholes. The second larval brood observed in September resulted when an unusual storm deposited 0.91 inch of rain in the general area in late July.

The fourth hind-tarsal segment of adult females reared from these larvae is white ringed at the base. The larvae possess hair 11 of the first abdominal segment and, therefore, according to Belkin and McDonald (1957), are *A. sierrensis* (Ludlow) and not *A. varipalpus* (Coq.).

Collection Data:

DOUGLAS COUNTY: Glenbrook, adult, VIII-25-15 (Dyar, 1922).

ORMSBY COUNTY: Carson City, adult, VII-2-53 (Richards *et al.*, 1956).

WASHOE COUNTY: Mt. Rose (Thomas Creek), IV-19-60, 6,500 and 7,500 feet; larvae, IX-13-60, 6,500 feet; Lake Tahoe, females, VII-12-60, females, IX-13-60, 6,700 feet.

Uranotaenia anhydor DYAR

This species was previously known from Nevada only by six females collected at lights by C. B. and R. N. Philip at Fairbanks Springs in Ash Meadows, Nye County (Freeborn and Bohart, 1951). In addition *U. anhydor* is known from Arizona and California. Belkin and McDonald (1956) presented an excellent taxonomic and ecological discussion of the *U. anhydor* complex.

The writer surveyed a small portion of Ash Meadows in the Amargosa Desert in July and collected several dozen larvae in the fourth-instar stage only from one small, partially shaded depression adjacent to a fresh-water spring. The dominant vegetation was common three-square (*Scirpus olneyi* Gray). No adults of this species were observed. Larvae of *Culex tarsalis* Coq., *C. erythrothorax* Dyar, and *Anopheles freeborni* Aitken were found in adjacent pools. The water level of the various springs was apparently much lower than usual, which might have contributed to the scarcity of *U. anhydor* larvae.

The chaetotaxy of these larvae appears to be very similar to the Saratoga Springs population of *U. anhydor* depicted by Belkin and McDonald (1956).

Collection Data:

NYE COUNTY: Ash Meadows (Amargosa Desert), larvae, VII-19-60; Ash Meadows (Fairbanks Springs), females, VIII-21-49 (C. B. and R. N. Philip).

SUMMARY. *Culex apicalis* and *Psorophora confinnis* are added to the mosquito fauna of Nevada. Larvae of *Aedes sierrensis* and *Uranotaenia anhydor* were collected for the first time in the State. Ecological information, associated species, and localities are given for these four species.

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UTAH MOSQUITO ABATEMENT ASSOCIATION

Sixty per cent of the people in the state of Utah are now living within the boundaries of organized mosquito abatement districts.

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SCIENTIFIC NOTES

THE EFFECT OF VARIOUS CONTAINER MATERIALS ON DILUTE DDT SOLUTIONS [1]

L. COLIN CURTIS [2]
Canada Agriculture Research Station,
Kamloops, B. C.

In the course of the program of testing mosquitoes for possible resistance to larvicides, using the standard World Health Organization kit, it frequently happens that tests must be conducted far from headquarters. This involves the transportation of the full complement of glassware into sometimes remote and rugged terrain. To improve the portability of the outfit and reduce breakage, nesting twelve-ounce containers made of other materials were considered in place of the glass vessels specified in the WHO procedure. These would be usable only if they could be relied upon to give results at least as valid as those resulting from the use of glass. Bowman *et al* (1) have shown that even in glass containers there is a rapid degradation of dilute DDT suspensions.

A bio-assay technique was used in this study to compare the practical results obtained through the use of glass, aluminum, polyethylene, enamelled steel, and waxed paper containers for the test insects in the WHO procedure. The larvae used were 3rd and 4th instar *Aedes aegypti* L. of a laboratory strain, 25 to a container. Containers were replicated three times at each concentration. The DDT, used at concentrations of 0.02 p.p.m. and 0.004 p.p.m. was obtained from a fresh WHO kit. The containers were as follows:— (a) glass crystallizing dishes with vertical sides and an inside diameter of 3¾"; (b) cylindrical aluminum measuring cups, i.d. 3½"; (c) half-pint waxed paper freezer cartons, i.d. 3⅜"; (d) 12-ounce polyethylene vessels with tapering sides and a water-line diameter of 3⅜". (e) white enamel pudding dishes with tapering sides and a water-line diameter of 6¾".

In order to determine if the polyethylene containers could accumulate appreciable amounts of DDT from previous use by adsorption, one set of these vessels was repeatedly exposed to solutions of 0.5 p.p.m. DDT for 24-hour periods, separated by normal laboratory washings. The other set was brand new. Between tests of the two concentrations all vessels were thoroughly scoured with detergent, and all but the used polyethylene were rinsed with iso-octane. The

TABLE 1.—Percentage mortality of 3rd and 4th instar larvae of *Aedes aegypti* L. after exposure in various containers to DDT at concentrations of 0.02 and 0.004 p.p.m. for 24 hours

Container material	Concentration p.p.m.	Total of 3 test groups *					
		Alive	Moribund	Dead	M + D	Percentage M + D	
Aluminum	0.02	0	49	26	75	100.0	..
	0.004	68	5	2	7	..	9.3
Glass	0.02	0	42	8	50	100.0**	..
	0.004	63	9	3	12	..	16.0
Polyethylene (new)	0.02	2	46	27	73	97.3	..
	0.004	75	0	0	0	..	0.0
Polyethylene (used)	0.02	9	59	7	66	88.0	..
	0.004	74	0	1	1	..	1.3
Paper	0.02	2	70	3	73	97.3	..
	0.004	75	0	0	0	..	0.0
Enamel	0.02	0	51	24	75	100.0	..
	0.004	64	11	0	11	..	14.6†

* Corresponding control groups of 25 living specimens each showed no deterioration of condition or mortality during the test periods.

** Two containers only.

† Higher surface ratio.

L.S.D., 0.02 p.p.m.: 1%—12.29 L.S.D., 0.004 p.p.m.: 1% —8.78.
5% — 8.77 5% —6.72.

[1] Contribution No. 11 from Entomology Laboratory, Canada Agriculture Research Station, Kamloops, B. C.

[2] Assistant Entomologist.

standard WHO procedure was followed throughout the tests.

The mortalities obtained at the two concentrations are shown in Table 1.

At the 0.02 p.p.m. concentration, the percentage kill in none of the containers differed significantly at the 1 percent level, although used polytheylene showed a difference at the 5 percent level. At the 0.004 p.p.m. dilution the glass, enamel, and aluminum containers were significantly superior to the others but did not differ markedly from each other. In the used polyethylene set there was some indication of the effect of accumulated DDT, though not at a statistically significant level. It would appear, therefore that glass is definitely the material of choice. Schmidt and Weidhaas (2) have shown that an increased ratio of surface to volume markedly reduces the rate of kill. This factor should be considered in the case of the enamel dishes. However, due to its weight and chipping propensity, enamel offers no material advantage in portability over glass.

References

1. BOWMAN, M. C., ACREE, F. JR., SCHMIDT, C. H. and BEROZA, M. 1959. Fate of DDT in larvicide suspensions. J. Econ. Ent. 52(6): 1038–1042.

2. SCHMIDT, C. H., and WEIDHAAS, D. E. 1959. Effect of varying conditions in a laboratory testing technique on the mortality of mosquito larvae. J. Econ. Ent. 52(5):977–979.

Culiseta melanura (COQ.) BREEDING ON LONG ISLAND, N. Y.

HUGO JAMNBACK
New York State Museum and Science Service

The isolation of eastern encephalitis (EE) virus from Pekin ducks on Long Island by Dr. E. Daugherty III and co-workers at the Duck Disease Research Laboratory in 1959 (Collins, 1960), suggested the advisability of locating areas where *C. melanura* was breeding, since this mosquito is the chief suspect in bird to bird transmission of the disease.

This species breeds in restricted habitats often overlooked in routine mosquito control work. Typically, these habitats are located in cold water, especially sphagnum bogs, either in depressions in the sphagnum or in the holes left when trees are knocked down or blown over (stump holes). Although these breeding sites may contain large amounts of water, the openings at ground level are often rather small so that they are difficult to locate.

Figure 1 shows all of the *Culiseta melanura* breeding areas found up to April 1961 and also sites from which EE has been isolated. These include records of larval collections by the personnel of the N. Y. State Museum and Science Service, Suffolk County Mosquito Control Commission and Nassau County Mosquito Control Commission. Records of virus isolations were ob-

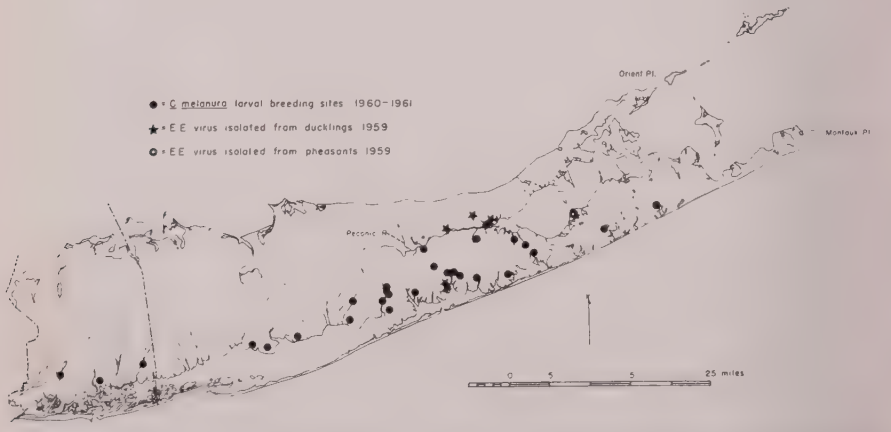
● = C. melanura larval breeding sites 1960–1961
★ = E E virus isolated from ducklings 1959
✪ = EE virus isolated from pheasants 1959
Orient Pt.
Montauk Pt
Peconic R.
0 5 5 25 miles

FIG. 1.—Outline map of Long Island, New York showing *Culiseta melanura* breeding locations and sites from which EE was isolated.

tained from the Duck Disease Research Laboratory (Eastport, N. Y.) and the Division of Laboratories and Research, N. Y. State Health Department.

Most of the *C. melanura* breeding sites were found in the Peconic River drainage system and near the cool, spring-fed streams flowing into the bays along the south shore. It was interesting to note that the breeding sites in densely populated areas of Nassau and Suffolk counties were restricted to undisturbed parks and large estates. No breeding was found along the north shore of Long Island, which has few undisturbed cold streams or bogs due, in part, to the dense population in the western part and extensive potato farms in the eastern part.

Reference Cited

Collins, D. L. 1960. Status of eastern equine encephalitis and the mosquito vector potential in New York State. N. Y. State Jour. Med. 60:1225–1229.

OPERATIONAL NOTES

Improved Urban Adult Control Operations with an Electric Clutch

G. A. Thompson
Director, Jefferson County (Texas) M.C.D.

In 1958 the Jefferson County (Texas) Mosquito Control District redesigned their eight Buffalo Turbines so that they could be operated by one man, rather than the two men previously used. There were numerous technical difficulties that needed solving. One of the more annoying was the deposition of dust in the turbine funnel and on the ground while the operator was loading the hopper. Unless the engine was stopped while loading, enough dust fed into the blower to deposit sufficient dust on the ground to burn grass and other vegetation. This resulted in a few complaints.

The regular mechanical clutch was provided with a control so that it could be operated from the driver's seat. The early attempts used an iron rod from the clutch arm, through the back of the cab of the truck and into the cab next to the driver. Although the design worked, it was very noisy and necessitated constant maintenance to keep the clutch adjusted. A second design involved the use of flexible cables, such as are used on boats to control the engine from a position at the wheel. These cables are capable of transmitting up to a thirty-pound thrust. The flexible cables were an improvement but were not the answer to the problem.

A search for a device to disengage the engine from the turbine and agitator led to the installation of an electric clutch. It is recommended that a "coupling-clutch" be used. A simple clutch requires a much greater degree of shaft alignment than is necessary with the coupling-clutch. The latter costs but little more, and installation is rather simple. In the normal construction of a Buffalo turbine, the drive pulley for the agitator is located on the engine side of the coupling to the turbine. This drive pulley should be relocated on the turbine side of the new coupling-clutch, completely disengaging the engine from the dusting mechanism. In the event that the modification is made to the small Buffalo that is simply a duster, the old mechanical clutch can be inactivated and remain in place as a pulley. We have had no experience with the electric clutch on the sprayer-duster models.

The ratings as published by the electric clutch manufacturer show that a 6" clutch should transmit the torque of an 8.25 horsepower engine, the normal power supply for the small turbine. However, to be on the safe side, we installed the 8" clutch. We do not recommend the smaller clutch as there is considerable slippage when the 8" clutch is engaged. We were unable to secure satisfactory performance with the one six-volt clutch we bought for installation on an old truck. A twelve-volt system seems to provide ample magnetic force to keep the clutch engaged. Once the clutch is adjusted properly there is little maintenance to the mechanical parts. However, the slightest weakness in any of the electrical connections will result in malfunction of the clutch. The electricity is carried to the electromagnet through a paired, double brush arrangement on commutator rings, very similar to the collector rings of an alternator. The positioning of the brush hanger is critical. Too little pressure results in poor contact and too much contact results in excessive brush wear. The brush assembly must be shielded as much as possible from dust to prevent excessive wear of the brushes and collector rings. Dust can also pack in the brush hanger and inactivate the brushes. We have found it advisable to maintain a good supply of brushes and brush hangers to avoid lengthy shut-downs.

We have found the electric clutch an efficient tool, improving public relations in our dusting program in urban areas. The complete shut-down of the dusting apparatus provides for dust-free cross streets, parked cars and areas inhabited by persons allergic to B.H.C. dust.

THE ONLY MOVING PART IS THE OPERATOR

T. G. RALEY
Manager, Consolidated Mosquito Abatement District
Selma, California

A practical, reasonably precise, method for applying granular insecticides by hand is now one mosquito season old at Consolidated (California) MAD. The experience was rewarding in direct economies to the District and in the pleasure expressed by all personnel with the easy, clean way to treat a multitude of mosquito sources. Modifications and improvements of the applicator and better techniques for using it will make it possible to start the 1961 season with confidence in our ground larviciding program.

Two things combined to encourage this District to initiate a full scale use of granular insecticides by all field personnel. Limited testing of commercial supplies of the new granular formulation recommended by Dr. Mir Mulla, University of California, Citrus Experiment Station, Riverside, in late 1959 were so successful, a crash program to develop a suitable hand applicator was started in the District shop as the mosquitoes eased off. The work of Dr. Mulla and his co-workers has already been reported in *Mosquito News* and other publications. The gratifying result of our search for a suitable piece of equipment to apply the new granules by hand may be of interest to other mosquito control agencies.

Without going into detail on the many hours spent in constructing the excellent hand crank rotary applicator shown in Figure 1, this method of applying granules does have merit and will be explored further. Power units mounted on vehicles have been proven in the field and several commercial hand models are used for applying herbicides, fertilizers, seeds, insecticides, etc. Our switch away from the hand crank applicator was due to the curiosity of Mr. A. L. Paden, District Entomologist.

In screening the available commercial seeders, Mr. Paden found a very simple device that caught his interest. He gambled the District would pay $1.75 for an experiment and bought one to try. As time permitted enough field testing he recommended setting aside all the other units and concentrating on the low priced HORN for the 1960 season. To the continuing benefit of the District and the gratitude of the field operators, he was able to support his recommendation with concrete evidence.

The original Cyclone HORN Seeder has been modified, remodified and then modified again. Parathion granules were being used by the District so our first modification was to have bags made from a material that would not soak up the toxicant and could be wiped clean as required. A zippered closure was included to protect the operator from spillage and fumes. This involved buying the seeder and having another firm make the bags. The cost per unit was still quite reasonable but dealing with two suppliers was awkward. Correspondence with the HORN manufacturer has been productive and they are now offering their first model of the "Skeeter-Bator" (Figure 2.) The price is nominal and buying several each year would not cost as much as the average spray can. A deluxe model incorporating all the safety features for handling organic phosphorous granules is being encouraged.

The advantages of an insecticide granule with a controlled release of the toxicant are obvious. An applicator where "The Only Moving Part is the Operator," completes a nice combination.

Another item that has this District quite excited is a plastic hose. From preliminary trials the hose looks as if it will last forever under conditions of use here at Consolidated. Costs are about one-third more than the conventional hose but the anticipated longer life should more than offset the difference. NYLOBRADE is light and pliable, making it easy to work with under field conditions.

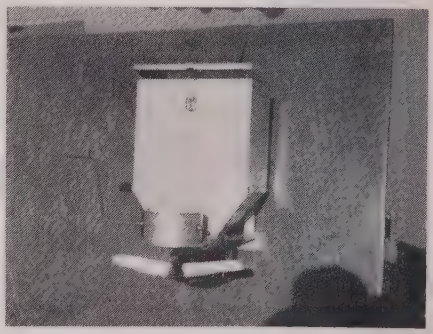

FIGURE 1.—Hand crank rotary applicator fabricated by Consolidated (California) MAD.

FIGURE 2.—"Skeeter-Bator" being demonstrated by A. L. Paden, Entomologist, Consolidated MAD.

EDITORIAL

S. G. BREELAND

Editor's Note: In a recent conversation, the senior author of the article "Observations on Mosquito Feeding Activity on the Flower Heads of *Eupatorium* and *Solidago*," which begins on page 32 of the March issue, advanced a number of interesting speculations engendered by the observations recorded. Although admittedly "speculative thoughts," they are of the type that may provoke discussion and stimulate others to do a little thinking; they are therefore presented on this page.

While the actual observations in themselves warrant recording as biological fact their real importance may lie in their implications. Some of these are as follows.

(1) Flowers may be a source of energy for female mosquitoes in their initial flight in search of blood. The establishment of an association between specific plant and mosquito species could possibly result in an added method of mosquito control, *i.e.*, the chemical or mechanical destruction of plants important to the species.

(2) Such an association also poses the question of whether a visit to a plant, perhaps more specific than now thought, is a prerequisite for some species to utilize or even desire a blood meal.

(3) Since the botanical family Compositae is a leading family as a drug source, *e.g.*, eupatorin, listed in Merck Index as a hemolytic, perhaps hypersensitivity to mosquito bites is associated with whether or not the mosquito has previously visited a flower head of one of these plants.

(4) Food from specific plants may be necessary to stimulate mating and or blood feeding, a knowledge of which could provide the key for establishing insectary colonies of certain species.

These speculative thoughts are being pondered by TVA biologists. Some of them will be pursued further. Since several workers have verbally expressed interest in these implications, they are being passed along to the reader with the hope that interest will be stimulated in this neglected area of mosquito biology.

OPERATIONAL NOTES

At every annual meeting for the past few years, the Editor, in his report, has urged the members to cooperate in supplying more "Operational Notes." Many members also have urged the inclusion of more such contributions. The Editor has tried to emphasize that it is up to the individual members to submit them. If we do not print enough "Operational Notes" to satisfy those who wish to have more, it is because they have not made their contributions.

In an effort to stimulate interest in this part of the Section hitherto known as "Operational and Scientific Notes," it has been decided to set up two sections, one for the "Scientific Notes" and one for the "Operational Notes." Bruce Brockway has agreed to act as Associate Editor for the "Operational Notes" section. With the assistance of his well known drive and enthusiasm, we can look forward to an increase in the contributions of the nature that so many of the field men would like to see. All members are urged to give Bruce their cooperation and support.

ASSOCIATION NEWS

MINUTES OF THE 17TH ANNUAL MEETING OF THE AMERICAN MOSQUITO CONTROL ASSOCIATION

ANAHEIM, CALIFORNIA, JANUARY 30–FEBRUARY 2, 1961

RECORDED AND REPORTED BY
ERNESTINE B. THURMAN

A meeting of the Board of Directors of the American Mosquito Control Association was convened at the Disneyland Hotel, Anaheim, California, at 9:00 a.m., January 30, 1961, by President Daniel M. Jobbins. Members of the Board present were: W. E. Bickley, President-Elect; A. F. Geib, Vice President; A. D. Hess, Past President; T. G. Raley, Executive Secretary; L. W. Smith, Treasurer; Ernestine B. Thurman, Recording Secretary; and Regional Directors: V. Conant, North Atlantic; J. A. Mulrennan, South Atlantic; C. F. Scheel, Northeast Central; C. D. Grant, South Pacific; C. M. Gjullin, North Pacific; O. P. Breland, Southwest Central; and J. E. Graham, Northwest Central. Absent were: R. W. Bunn, Southeast Central; B. Hocking, Canada; and L. Vargas, Mexico, Central and South America. Twenty committeemen and other members of AMCA were also present.

President Jobbins called the meeting to order with the roll call.

The minutes of the 16th Annual Meeting of AMCA were presented as published (*Mosquito News,* 1960, Vol 20, No. 2, pp. 193–215). A motion for approval, made by T. G. Raley and seconded by L. W. Smith, carried.

President Jobbins appointed the following Resolutions Committee: H. F. Gray, Chairman; B. B. Pepper, and D. M. Rees.

The President submitted his annual report (Attachment #1). A motion for acceptance of the report, made by C. F. Scheel and seconded by A. D. Hess, carried.

The president called for reports from officers and chairmen of committees and subcommittees.

Nominating Committee: (Attachment #2)

A. D. Hess presented the report of the Nominating Committee and the slate of nominees. Instructions for voting were given. W. E. Bickley moved acceptance of the report; C. M. Gjullin seconded; carried.

President Jobbins appointed the Inspectors of the Election: R. L. Vannote, Chief Inspector; L. R. Brumbaugh, and W. N. Cox.

Finance and Policy Council: (Attachment #3)

C. F. Scheel presented the report of the Policy and Finance Council, and moved acceptance of the aims and objectives of the Council; W. E. Bickley seconded; carried.

A. D. Hess moved that the Policy and Finance Council be composed as a 5-man committee appointed by the President plus the Executive Secretary and Treasurer as ex-officio members; W. E. Bickley seconded; carried.

A. D. Hess moved that the Chairman of the Bylaws Committee, with the assistance of the Chairman of Finance and Policy Council, draft an amendment to change certain duties from the Treasurer to the Executive Secretary; the duties of billing and collecting of dues of AMCA to be transferred to the office of the Executive Secretary as soon as feasible; W. E. Bickley seconded; carried.

A. F. Geib moved that the Board of Directors consider an increase in rates of advertising in *Mosquito News;* T. G. Raley seconded; motion tabled.

Treasurer: (Attachment #4, Audit Report)

L. W. Smith reported that the audit report had been submitted to and reviewed by the Board of Directors, and that current bills were paid. T. G. Raley moved acceptance of this general report; A. F. Geib seconded; carried.

Committee on Publication of Mosquito News (Editorial Board):

In the absence of the Committee Chairman, K. L. Knight, excerpts from a letter from Captain Knight were read by President Jobbins. No formal report was prepared.

Close liaison was maintained between the Editor and the Chairman. The committee has been at the service of the editors in reviewing manuscripts. The Chairman recommends changing the name of *Mosquito News* to *The Journal of the American Mosquito Control Association* or some equivalent title.

O. P. Breland endorsed the recommendation for changing the name of the official publication of AMCA, and presented a statement prepared by D. W. Micks further emphasizing the desirability of changing the name of *Mosquito News* to *The Journal of the American Mosquito Control Association.*

O. P. Breland moved that the cover of *Mosquito News* carry the wording "The Journal of the American Mosquito Control Association" as a subtitle beginning with the next issue or as soon as feasible, and that the wording be consistent wherever it should appear throughout *Mosquito News;* A. D. Hess seconded; carried.

O. P. Breland moved that the Publications Committee investigate the needs for changing the name of the official publication of AMCA and report to the Board of Directors at the next annual meeting; A. D. Hess seconded; carried.

Editor's Report: (Attachment #5)

In the absence of the Editor, D. L. Collins, the report was read by W. E. Bickley. A. F. Geib

moved tentative acceptance of the report with final action to be taken upon the arrival of the Editor; A. D. Hess seconded; carried.

News and Notes:

A. W. Morrill, Jr., reported briefly on the scope of the material published and the need for additional operational notes.

Program Committee:

A. F. Geib exhibited the published program in lieu of a formal report.

Local Arrangements:

J. H. Kimball urged full participation in the planned activities.

G. C. McFarland reported on the procedures for planning and conducting the meeting and announced that he was preparing a brochure on the subject to be available for future hosts to AMCA.

International Exchange and Good Neighbor Club:

E. B. Thurman reported that clerical duties of the Club were being transferred to the office of the Executive Secretary; that 62 Good Neighbors had been sponsored to date for 1961; and that more than 150 candidates were waiting to be sponsored.

Miscellaneous Publications:

C. D. Grant exhibited a copy of *Organization for Mosquito Control,* Bulletin #4 of the AMCA series of bulletins. T. G. Raley moved that Bulletin #4 be sold for $2.00 per copy; J. A. Mulrennan seconded; carried.

H. F. Gray recommended that the President-Elect, Executive Secretary, and Chairman of the Publication Committee determine a scale of costs for bulk orders of Bulletin #4.

C. D. Grant recommended consideration of revising Bulletin #1 and preparing additional bulletins dealing with larvicides and source reduction. T. G. Raley moved acceptance of the recommendation; A. F. Geib seconded; carried.

Membership: (Attachment #6)

In the absence of the Chairman, B. H. Brockway, the report was read by A. F. Geib. W. E. Bickley moved acceptance of the report; A. F. Geib seconded; carried.

Research and Development: .

In the absence of the Chairman, A. W. A. Brown, excerpts from a letter from Dr. Brown were read by President Jobbins. No formal report was prepared.

Bylaws Committee: (Attachment #7)

J. A. Mulrennan presented the proposed amendments to the Bylaws of AMCA and moved acceptance of the report; C. D. Grant seconded; carried.

T. G. Raley moved to return the report of the Bylaws Committee to the Committee for further action with power to inform the membership of AMCA of the proposals involved in order that the members might vote at an unspecified date; W. E. Bickley seconded; carried.

C. D. Grant presented a written request from A. D. Hess that Mr. Grant be authorized to serve as proxy for him. W. E. Bickley moved approval; O. P. Breland seconded; carried.

J. A. Mulrennan, in accordance with instructions of the Board, submitted proposed amendments to the Bylaws of AMCA relative to changes in the duties of the Executive Secretary and the Treasurer (Attachment #8). W. E. Bickley moved acceptance of the proposal with a recommendation for affirmative action by the membership at the annual business meeting; J. E. Graham seconded; carried.

Finance and Policy Council Report on Budget: (Attachment #9)

C. F. Scheel presented the proposed budget for 1961. J. A. Mulrennan moved acceptance; W. E. Bickley seconded; carried.

J. A. Mulrennan recommended that the Board commend C. F. Scheel for his worthy contributions to AMCA.

Advertising Manager: (Attachment #10)

F. P. Creadon presented his report as Advertising Manager. He recognized the need for increasing advertising rates and recommended that the matter be considered.

National Advisor: (Attachment #11)

R. L. Vannote presented his report as National Advisor. C. F. Scheel moved acceptance of the report; A. F. Geib seconded; accepted.

Executive Secretary (Attachment #12)

T. G. Raley presented his report as Executive Secretary. J. A. Mulrennan moved acceptance of the report; A. F. Geib seconded; carried.

A. F. Geib moved acceptance of the new members reported by the Executive Secretary; W. E. Bickley seconded; carried.

Adjourned 5:00 p. m.

PRELIMINARY BUSINESS MEETING—AMERICAN MOSQUITO CONTROL ASSOCIATION
DISNEYLAND HOTEL, ANAHEIM, CALIFORNIA
JANUARY 31, 1961, 9:15 A.M.

The meeting was called to order by President Daniel M. Jobbins, who asked for a report from the Nominating Committee. T. G. Raley presented the slate of nominees and announced the rules of the election by ballot. Nominations were invited from the floor. None were made.

President Jobbins announced the appointment of the Inspectors of Election: R. L. Vannote, Chief Inspector; L. R. Brumbaugh, and W. M. Cox; and the members of the Resolution Committee: H. F. Gray, Chairman; B. B. Pepper, and D. Rees.

President Jobbins called attention to the proposed amendments to the Bylaws as circularized earlier.

Adjourned 9:30 a.m.

Top: Richard F. Peters and Roy F. Fritz beam with satisfaction upon hearing that the 1962 Annual Meeting is scheduled to take place in Galveston. *Center left:* William Bollerud, manager (left), Durham (Calif.) Mosquito Abatement District discusses exhibit material with Boyd Lafferty, Supt. Cape May County (N. J.) Mosquito Extermination Comm. at attractive N. J. Mosq. Ext. Assn. exhibit set up by Mr. Lafferty. *Center right:* The Editor (Don Collins), speaks while Ted Raley, Ex. Sec. AMCA, listens intently, and Ernestine Thurman, Recording Secretary busily takes notes. *Bottom left:* Dr. Paul F. Meyer, member of the governing board of the Jefferson County (Texas) Mosquito Control Organization examines a low pressure "off-the-road" tire for use on jeeps. *Bottom right:* Veteran malaria control authority, Dr. Louis L. Williams (left), examines mosquito control publication at California Mosquito Control Assn. exhibit with Dr. René Rachou of Brazil.

GENERAL BUSINESS MEETING—AMERICAN MOSQUITO CONTROL ASSOCIATION
DISNEYLAND HOTEL, ANAHEIM, CALIFORNIA
FEBRUARY 1, 1961, 10:35 A.M.

The meeting was called to order by President Jobbins, who reviewed the highlights and business activities of the Association during the past year as shown in his annual report and the minutes. President Jobbins referred to the opportunities for AMCA to render greater service to basic operation of mosquito control, and spoke of developing a better balance among all interests of the Association during this "Year of Consolidation."

President Jobbins announced the rules and procedures for voting and instructed the Inspectors of the Election to close the ballot box at 10:50 a.m.

President Jobbins called for highlights of the reports of officers and chairmen of committees and subcommittees, the full reports having been presented earlier to the Board of Directors.

L. W. Smith, Treasurer, reported that the Association was solvent; that the auditor's report would appear in *Mosquito News;* and that all current bills had been paid.

C. F. Scheel, Chairman of the Policy and Finance Council, announced that the budget as approved by the Board of Directors was posted in the Board Room and all members were invited to examine it.

D. L. Collins, Editor of *Mosquito News,* compared the Journal of 1955 (Volume 15) with that of 1960 (Volume 20) in printing costs, number of copies printed per issue, and pagination, and called attention to the needs for Volume 21: an increase to 1800 copies per issue; more articles in "News and Notes"; the selection of an Associate Editor for "Operational Notes"; and the cooperation of authors in submitting more concise, shorter papers. The Editor reported that papers of the current meeting with certain exceptions, e.g. those specifically cleared for *Mosquito News,* would appear in the Proceedings of the California Mosquito Control Association with abstracts of AMCA papers in *Mosquito News;* according to the same plan adopted after the last previous California meeting.

J. A. Mulrennan, Chairman of the Committee on Bylaws, presented the proposed amendments to the Bylaws of AMCA (see page 5) as accepted by the Board of Directors (Article IV, Section 2; Article VII, Sections 1, 2, and 3; and Article VIII, Sections 2 and 3).

C. T. Williamson moved that the proposed amendments be read; A. F. Geib seconded; carried. J. A. Mulrennan read the proposed amendment to Article IV and moved adoption; W. Miller seconded; carried.

E. C. Robinson moved that the wording of the amendment to Article IV be referred to the Bylaws Committee for further consideration in designating the mechanics of activating the changes approved; F. C. Bishopp seconded; carried (1 negative).

J. A. Mulrennan read the proposed amendments to Article VII, Sections 1, 2, and 3, and moved adoption; A. F. Geib seconded; carried (1 negative).

J. A. Mulrennan read the proposed amendments to Article VIII, Sections 1 and 2, and moved adoption; G. C. McFarland seconded; carried (4 negatives).

C. A. Vieser moved that in case of a tied vote by letter ballot, the decision should be made by those present and voting at the next annual meeting; R. F. Peters seconded; carried.

J. A. Mulrennan read proposed amendments to the Bylaws setting forth changes in the duties of the Executive Secretary and the Treasurer, (Section IV and Section VI) and moved approval; R. F. Peters seconded; carried.

B. B. Pepper conveyed greetings from the New Jersey Mosquito Extermination Association to the California Mosquito Control Association and AMCA. He issued an invitation to the 48th annual meeting of the NJMEA in Atlantic City, New Jersey, on March 29–31, 1961.

H. F. Gray, Chairman of the Committee on Resolutions, read seven resolutions (Attachment 13) and moved approval of each. A. F. Geib seconded Resolution #1; C. D. Grant seconded Resolution #2; F. C. Bishopp seconded Resolution #3; B. B. Pepper seconded Resolution #4; J. A. Mulrennan seconded Resolutions #5, #6, #7; carried.

President Jobbins called for election returns from the Chief Inspector of the Election, R. L. Vannote, who reported the unanimous election of all unopposed nominees, and that V. Conant was elected as Director from the North Atlantic Region and H. Greenfield from the South Pacific Region.

G. C. McFarland moved acceptance of the report of the Inspector of the Election; J. A. Mulrennan seconded; carried.

C. T. Williamson moved endorsement of the activities of the Board of Directors and members of AMCA; R. F. Peters seconded; carried.

Past Presidents escorted the newly elected officers and presented them to President Jobbins. President W. E. Bickley was presented by F. C. Bishopp; President-Elect A. F. Geib by D. M. Rees; and Vice-President D. W. Micks by C. T. Williamson. President Bickley accepted the gavel from Past President D. M. Jobbins, acknowledging the honor and responsibilities and expressing appreciation to the officers and members. President Bickley presented the members elected to the Board of Directors; V. Conant, C. F. Scheel, O. P. Breland, and H. R. Greenfield. A. W. A. Brown, Regional Director for Canada, was not present. L. W. Smith and T. G. Raley were recognized.

Bartnell moved that future Committees on Local Arrangements for AMCA meetings give consideration to including costs of planned activities in the registration fee; W. Miller seconded; carried.

The meeting was adjourned at 12:15 p.m.

Photos made during tour following 1961 AMCA-CMCA Mtgs.

Top: Visit to Encephalitis Laboratory at Bakersfield, Calif. Jointly operated by U. S. Public Health Service, Univ. of California and Calif. State Bureau of Vector Control. *Center:* Dairy drain in Delta Mosquito Abatement District (Tulare County) improved by landholder in cooperation with District. Was formerly overgrown with so dense a stand of tules and cattails that spraying was impractical. *Bottom:* At Merced County Mosquito Abatement Dist. New hangars for aircraft built by District Personnel. District owns and operates 4 "Call-Air" special planes for airspraying. Principal larvicides are parathion and malathion.

MEETING OF BOARD OF DIRECTORS, AMCA
DISNEYLAND HOTEL, ANAHEIM, CALIFORNIA
FEBRUARY 2, 1961, 4:45 P.M.

A meeting of the 1961 Board of Directors of the AMCA was convened at the Disneyland Hotel, Anaheim, California, on February 2, 1961, at 4:45 p. m. with President W. E. Bickley presiding. Other members of the Board present were: A. F. Geib, President-Elect; D. M. Jobbins, Past President; T. G. Raley, Executive Secretary; L. W. Smith, Treasurer; Ernestine B. Thurman, Recording Secretary; and Regional Directors: V. Conant, J. A. Mulrennan, C. F. Scheel, C. A. Vieser (proxy for O. P. Breland), J. E. Graham, and H. Greenfield. Absent were: D. W. Micks, Vice President; and Regional Directors: R. W. Bunn, A. W. A. Brown, L. Vargas, C. M. Gjullin, and O. P. Breland (represented by proxy). Seven committeemen and other members of AMCA were present.

L. W. Smith moved acceptance of C. A. Vieser as proxy for O. P. Breland; J. A. Mulrennan seconded; carried.

President Bickley presented a list of committee chairmen and suggested committee members. A. F. Geib moved acceptance of the list with the suggested changes; V. Conant seconded; carried (Attachment #14).

T. G. Raley moved to authorize the Editor and Editorial Board to appoint an Associate Editor for Operational Notes; J. A. Mulrennan seconded; carried. T. G. Raley moved that President Bickley write a letter to Dr. Hugh Flick, Associate Commissioner of the New York State Education Board, commending the outstanding work of D. L. Collins as Editor of *Mosquito News*. L. W. Smith moved that the proposed budget be approved and that the Board be contacted to amend the budget item dealing with the office of the Executive Secretary when the change of duties of the Executive Secretary becomes effective; J. A. Mulrennan seconded; carried.

A. F. Geib moved that the budget item for clerical help be divided among the offices of the Executive Secretary, Treasurer, Editor, Advertising Manager, and National Advisor; H. Greenfield seconded; carried.

A. F. Geib moved that the budget item for travel be allotted as $150.00 each for the offices of Executive Secretary, Editor, Advertising Manager, and Treasurer; A. D. Hess seconded; carried.

L. W. Smith moved that $50.00 be paid to the Executive Secretary from the 1961 contingent fund for travel to the 1961 meeting; V. Conant seconded; carried.

T. G. Raley moved that D. M. Jobbins be appointed Assistant Treasurer of AMCA; A. D. Hess seconded; carried.

T. G. Raley moved approval of the publication of papers from the 1961 AMCA meeting in the Proceedings of the CMCA in lieu of a monetary contribution from CMCA to AMCA, with copies distributed to members of AMCA and subscribers of *Mosquito News;* A. D. Hess seconded; carried.

E. B. Thurman reported 23 Good Neighbors had been sponsored during the AMCA meeting bringing the total to 85 for 1961.

J. A. Mulrennan moved that the Board reconfirm the acceptance of the invitation from the Texas Mosquito Control Association for AMCA to hold its annual meeting in 1962 with the TMCA in Galveston, and that the dates of the meeting be set so as not to conflict with the annual meeting of the New Jersey Mosquito Extermination Association; L. W. Smith seconded; carried.

L. W. Smith recommended that all annual meetings of state associations be listed in *Mosquito News* and that the Executive Secretary make the necessary arrangements.

J. A. Mulrennan moved that all degree designations be excluded from the program of the AMCA meetings; L. W. Smith seconded; carried.

A. F. Geib announced that H. F. Gray is offering the copyright for the revision of *Mosquito Control,* by Herms and Gray, to AMCA. L. W. Smith moved that the Editorial Board consider this offer; D. M. Jobbins seconded; carried.

A. F. Geib moved that the Advertising Manager be authorized to raise the rates for advertising in *Mosquito News* in accordance with those of similar journals; A. D. Hess seconded; carried.

A. D. Hess moved to authorize the Recording Secretary to condense the minutes and attachments; V. Conant seconded; carried.

In conclusion, President Bickley mentioned some matters that the Association should consider during 1961:

1. An amendment to the Bylaws to define a quorum at business meetings.
2. A provision for amending the Bylaws by mail vote.
3. Advising the membership through *Mosquito News* of proposed amendments to the Bylaws.
4. A confirmation from nominees of their willingness to serve if elected.
5. A revision of AMCA Bulletins #1, #2, and #3 or combinations of the Bulletins.
6. Standards for chemical control on a regional basis.
7. The possible desirability of affiliation with the American Institute of Biological Sciences.
8. A published list of the states in each region of AMCA.
9. A published list of members of AMCA.
10. A consideration of prices for bulk orders of AMCA Bulletin #4.
11. Members from West Virginia in AMCA, West Virginia being the only state not receiving *Mosquito News.*

The meeting was adjourned at 6:30 p.m.

ATTACHMENT #1

REPORT TO THE BOARD OF DIRECTORS

In this year of consolidation of administrative services in the office of the Executive Secretary,

your President has been concerned primarily with the basic objectives of the association and ways in which the organization may be of greater service to all the multiple interests concerned with mosquito problems. Personal contacts at regional, national and international meetings and with members representing industry and government have been the chief sources of the opinions and suggestions which are now brought to your attention.

In administrative matters where there have been departures from conventional procedures of inquiry and communication, they have been the result of unusual pressures and limitations which I trust have not harmed any of the cooperative relationships which exist throughout the association.

Through the Executive Secretary, major committees have functioned in the continuance of established activities and progress on these matters will be reported to you directly. Highly significant are the matters of policy and finance.

During the year the unique position of the AMCA as a meeting place for many professional disciplines has been repeatedly emphasized as one of its principal opportunities for service.

Among items in this regard which may warrant attention of the Board and future committees, are suggestions for the wider use of association publications, internationally, for service and to attract membership from related fields. In addition, the development of specific projects under the Directors in the several regions can publicize the Association and bring forth practical information related to mosquito control of the type not usually presented in technical articles.

Concerning publications:

1. It has been suggested the great value of *Mosquito News* in presenting a cross-section of information on applied mosquito control as well as scientific articles has not been fully exploited in the international area where control techniques are being re-evaluated as programs grow to a maintenance status.

   The distribution of selected reprints from *Mosquito News* for quotation, translation and permission for republication abroad, for example, has been suggested to fortify Good Neighbor Club activity and to attract added membership.

2. In discussions with individuals at regional and the national meetings there was expressed a real need for a new bulletin on Ground Equipment and Chemicals for Mosquito Control with recommended standards for various physiographic areas and types of economic development.

Concerning regional projects:

1. Since the recognized strength of the Association is derived from the regional segments, increased opportunities for closer contact between the Regional Directors and the membership has been an expressed desire of many. One suggestion for facilitating this has been delegation to Regional Directors, responsibility for the periodic review of all mosquito-related activities in the region. Such review would serve to increase personal contacts and bring to light for publication useful procedures and examples of operational situations which so often are local knowledge.

   The organization of regional field trips by the Directors once during their term of office has also been suggested.

In looking forward to further centralized administration of the Association, the proposals of the Finance and Policy Council are particularly recommended for your analysis from the long-range viewpoint.

ATTACHMENT #2

OFFICIAL REPORTING OF NOMINATING COMMITTEE. For *President,* W. E. Bickley; *President-elect,* A. F. Geib; *Vice President,* Don W. Micks; *Executive Secretary,* T. G. Raley; *Treasurer,* Lester W. Smith; *Director, North Atlantic Region,* Vernon Conant or Richard O. Hayes; *Director, Northeast Central Region,* Charles F. Scheel; *Director, Southwest Central Region,* Osmond P. Breland; *Director, South Pacific Region,* C. Donald Grant or Howard R. Greenfield; *Director, Canada,* A. W. A. Brown.

ATTACHMENT #3

ABSTRACT OF REPORT OF FINANCE AND POLICY COUNCIL

The objectives of the Finance and Policy Council are stated in a report published in *Mosquito News,* Volume 20, pages 201–203. Further planning has been done, and the advice of all past presidents of the Association has been obtained. Some comments were of a critical nature, particularly with reference to the procedures for elections of officers. The following projects are presented for the consideration of the Board of Directors.

1. *Consolidation of business activities.* The recommendations as given on page 215, Volume 20 of *Mosquito News* should be carried out as soon as practicable. Some of the activities mentioned have been consolidated in the office of the Executive Secretary.

2. *Grants in aid.* Further study of potential financial assistance has continued.

3. *Association bank balances.* The transfer of $2,000 from the regular account and $2,000 from the special publications account to a savings account took place early in 1960. The question of use of inactive funds was explored by the Council.

4. *Additional revenue from increased advertising and new membership.* Our Advertising Manager and Membership Committee Chairman are both doing an exceptional job in their respective assignments and are deserving of all the gratitude

and commendation the members can pass along to them. They are undoubtedly ever hopeful of constructive suggestions as to how to improve the activity in these fields and would certainly welcome the considered view of the Council in this respect.

The Regional Directors should aim toward reaching additional potential members from the District Boards, Trustees, Health Officers, Universities, Manufacturers of Field Equipment, Producers of Larvicides, etc. In the direction of possible increase in advertising there are perhaps many of our members using products of suppliers who do not advertise in *Mosquito News*. If these products are satisfactorily filling the needs of these members, it should not be too difficult to convince the supplier of the possibilities of a broader application of his wares through an ad in *Mosquito News*.

5. *District budget assessment.* A proposal to assess local district boards so that appropriations could be made at the time their annual budgets are being prepared was discussed. Local legal limitations may have to be reviewed.

ATTACHMENT #4

AMERICAN MOSQUITO CONTROL ASSOCIATION
METUCHEN, NEW JERSEY

Summary of Cash Receipts and Disbursements
Treasurer's Account

Year Ended December 31, 1960

	Checking Accounts			
	General Account		Special Publications	Savings Account #19400
RECEIPTS				
Balance on deposit—January 1, 1960		$ 9,664.79	$2,427.30	
Dues and subscriptions	$ 7,012.21			
Advertising	3,255.28			
Back issues	35.00			
Reprints	1,799.77			
Good Neighbor Club	20.00			
Bulletins	13.00			
Expense refunds	54.59			
C. T. Williamson—transfer of funds			694.30	
Mailing lists	90.00			
Transfers from checking accounts (contra)				$4,000.00
Unidentified deposit	5.00			
Sale of pins	72.00			
Interest credited				60.00
United States government grant	1,500.00			
Exhibits—Massachusetts meeting	1,500.00	15,356.85		
		25,021.64	3,121.60	4,060.00
DISBURSEMENTS				
Printing of *Mosquito News*, reprints and mailing charges	13,320.36			
Office supplies, expenses, etc.	294.67			
Postage	411.26			
Fidelity bonds	23.75			
Traveling expenses	500.00			
Exhibits—materials and expenses	304.33			
Convention expense—1960—Vienna	2,300.00			
Examination of Treasurer's records	100.00			
Refund to subscribers	17.50			
Purchase of desk and typewriter	103.88			
Bank charges	6.39			
Checks returned by bank	15.00			
Transfers to savings account (contra)	2,000.00	19,397.14	2,000.00	0
Balance—December 31, 1960 (on deposit—Commonwealth Bank of Metuchen, Metuchen, New Jersey)		$ 5,624.50	$1,121.60	$4,060.00

ATTACHMENT #5

REPORT OF EDITOR OF *Mosquito News*
On Volume 20 (1960)
January 15, 1961

Volume 20 of *Mosquito News* has been completed with the December, 1960 number, and it is an appropriate time to mention a suggestion that has been made and endorsed by several members, that the name of *Mosquito News* be changed to something "more dignified." Names such as "Journal of the American Mosquito Control Association" or "American Mosquito Control Association Journal," have been suggested. This subject is discussed further in another Attachment.

It is also an appropriate time to re-examine some of our policies, particularly the following:

1. *The rule giving priority on publication to members of AMCA:* Should it be interpreted strictly or loosely? Two of the most common dilemmas encountered in this policy are: (1) A paper by a non-member who belongs to an agency which may support AMCA by one or several subscriptions or memberships, and (2) A paper submitted by students or associates of a member, perhaps a frequent contributor himself, and who has possibly actually solicited the manuscript for us. It could grow into a real problem if students could take advantage of the membership of their teachers to publish free in *Mosquito News;* on the other hand, we ought to encourage publication of good papers if only in the hope that it would inspire the authors to join. The editor of another biological journal, when consulted, said he would publish one sponsored article for an author, with the hope of ultimately gaining his membership, "especially if and when he desired to publish again." This would seem like a reasonable policy. Another approach to the problem would be to allow 2 non-member articles per issue, one of foreign origin and one sponsored.

The question of allowing free publication just because the prospective author's organization subscribes or has other members, is another matter. In effect, this would be "family admission on one ticket." Here we might impose a limit of one such article per issue, or perhaps even limit it to one opportunity per volume for any one organization to take advantage of the privilege.

2. *Charges for extra pages, long tables and for more than 2 illustrations.* Questions on this matter have been raised from time to time. Since the rules on length and charges are clearly stated

	No. pages	
	Vol. 19	Vol. 20
Proceedings	69	73½
Articles	131½	201½
Operational & Scientific Notes	9	22½
Editorial	3½	0
Association News	25	46
News & Notes	15½	20
Reviews & Abstracts	4½	8½
Bibliography	35	34
Advertising	76	81
Miscellaneous	3	9
	372	496

Mosquito News
Comparison of statistics for last 5 volumes

Vol. no.	Year	Total cost	Copies	Total no. pages per vol.	Av. no. pages per issue	Min. & max. no. pp. per issue	
16	1956	$ 8,393.36	5800	392	98	68	152
17	1957	8,549.65	5850	408	102	84	120
18	1958	9,615.35	6600	416	104	68	152
19	1959	8,361.17	6650	372	93	64	112
20	1960	11,345.34	6800	496	124	96	172

Mosquito News
Statistics on volumes 19 and 20

	No. printed		No. pages		Cost	
	Vol. 19	Vol. 20	Vol. 19	Vol. 20	Vol. 19	Vol. 20
March	1,650	1,700	64	104	$1,591.77	$2,453.50
June	1,650	1,700	112	172	2,284.34	3,712.57
September	1,650	1,700	100	124	2,226.06	2,986.85
December	1,700	1,700	96	96	2,259.00	2,192.42
	6,650	6,800	372	496	$8,361.17	$11,345.34

on the inside back cover, and since it is the practice to cite these rules in acknowledging a long paper, either the editor has to abide by them, or they should be changed. The charges made have almost always been *below* cost, since we bill only at the average, even if the paper is over-loaded with tables and scientific names.

3. *Questions on reprint charges have also arisen.* The cost of 500 reprints of a 13-page paper in *Mosquito News* was compared with the cost of 500 reprints of a paper of similar length (in number of words) in another entomological journal. *Mosquito News* charges were less by $6.13 ($50.63 for *Mosquito News*, $56.50 for the other journal).

In conclusion, the statistics on the past two volumes are presented. The total bill of $11,345.34 for Volume 20 is somewhat in excess of the estimate in the budget, but I should point out that this was due largely to (1) the increased number of pages (124 more in Volume 20 than in Volume 19, equivalent to an entire issue), many of which, however, were paid for as excess pages by the authors) and to the larger number of copies printed, which, in turn were paid for, since they represented increased circulation. This, incidentally is useful to point out in soliciting advertising.

A comparison of statistics on the past 5 volumes shows there were 1,000 more "books" of Volume 20 printed than of Volume 16 (6800 total in 1960 as compared with 5800 in 1956), or an average of 1700 copies per issue of Volume 20 as against an average of 1275 copies per issue of Volume 16.

Attachment #6

Report of the Membership Committee

During the past year the membership has been increased by 75 to 80 members over the 1959 accounting. Furthermore, the number of delinquents has been greatly reduced as compared to other years. Of course the number of cancellations has been increased because of the harassment from the membership chairman, but there has been a total of 192 accounts to offset the 117 cancellations.

It is well to mention that the new membership gain all came from the direct or indirect contact of an AMCA member and not from a membership campaign that normally would be undertaken by the membership committee. This is indeed a compliment to the members of the Association.

All of us take pride in operating a balanced family or perhaps a balanced mosquito abatement budget. It takes cooperation for these things to happen; therefore, I would like to appeal to the membership committee for two cooperative efforts: One—pay dues on time. Two—each mosquito abatement district write at least one new member during 1961. This certainly would help membership chairmen for the coming year, and most of all, it will be enlarging the Association organization so that we will be even more proud of it than we are at the present time.

Your executive secretary would like to have an Association of at least 2,000. The membership can show him that we are solidly behind him even though it does make more work for him.

Attachment #7

Proposed Amendments to the Bylaws of the American Mosquito Control Association

Article IV. Regional Subdivisions

Section 1. Regions.—Leave intact

Section 2. Regional Directors. Change to read as follows.—There shall be a regional representative or regional director elected from each region to the Board of Directors of the Association. *The name of the regional director elected by the individual region for the ensuing two-year term, as provided in Article V, Section 1., b. (7), shall be presented to the regular business meeting of the Association during the annual meeting.* It shall be the duty of the director of each region to promote interest in the Association and to assist individuals, groups, and affiliated agencies in the region with matters pertaining to the Association and with local problems concerning mosquitoes and related pests.

Article VII. Nomination of Officers

Section 1. *Designation of a Nominating Committee.—The incoming President shall designate a nominating committee (in conformance with Article VI, Section 1., f.) composed of the outgoing President, as chairman, and one member from each region of the Association who is not at the time an officer or director.*

Section 2. Duties of the Nominating Committee.—The nominating committee shall submit *to the Executive Secretary four months prior to the next annual meeting its nomination or nominations, if not unanimous, for each office to be filled in the ensuing year.*

Section 3. Other nominations.—Amend by striking in its entirety

Article VIII. Annual Meetings and Election of Officers

Section 1. Annual Meetings.—Leave intact.

Section 2. Election of Officers.—Amend Section 2 by striking and substituting in lieu thereof the following:

Section 2. Election of Officers.—The Executive Secretary shall prepare a ballot containing the names of the nominees referred to him by the nominating committee and a space for a write-in candidate for each office, which ballot shall be mailed to every member in good standing approximately three months prior to the annual meeting. The ballot, in order to qualify for counting, shall be returned by the individual members to the Executive Secretary at latest by the date of the business meeting immediately previous to

the annual meeting. The ballots shall be opened and tallied by the Executive Secretary in company of at least two other officers or directors of the Association, and the results of the election shall be presented to the membership during the regular business meeting. All elective officers shall be elected by a plurality of the total votes cast for each office.

Section 3. Quorum.—Amend Section 3 by striking in its entirety.

ATTACHMENT #8

PROPOSED AMENDMENTS TO THE BYLAWS OF AMCA RELATIVE TO DUTIES OF EXECUTIVE SECRETARY AND TREASURER

Section 4. Amend Section 4 by striking and substituting in lieu thereof the following:

Section 4.—Executive Secretary.—The Executive Secretary of the Association shall have the following duties:

a. As Executive Secretary, he shall be responsible for setting in motion and following through with any action approved by the Board of Directors for:
   1. Current activities
   2. For further development of the Association, and
   3. For coordinating the objectives, policies, responsibilities and services of the Association.

b. The Executive Secretary of the Association shall be provided paid clerical services to:

   1. Prepare and keep up to date a membership roster, including such pertinent information about members as directed by the Board of Directors.

   2. In advance of the mailing date, advise the publisher of *Mosquito News* of any new names that should be added to, and of any names that should be dropped from, the mailing list, or confirm the existing mailing list if no changes are to be made.

   3. Collect and record all dues, and other moneys due the Association.

   4. For the collection of dues, he shall bill each member for current and unpaid dues and any other charges due the Association, at least one month before January 1.

   5. To reach members at least one month before the "delinquency" date, June 1, he shall send a "second notice" statement of still unpaid dues, quoting the bylaws to the effect that if dues are not paid by June 1, the member becomes automatically not in good standing and no longer eligible for membership privileges.

   6. Serve as custodian, distribute, bill and collect for all Association publications that are not mailed directly by the publisher.

   7. At least quarterly, transfer all money collected along with suitable information on its source, to the Treasurer.

c. As Secretary of the Corporation, he shall have custody of the Corporation Seal and shall execute with the Chairman of the Board all legal documents of the Association and affix the seal thereto, and in this capacity shall use the title Secretary of the Corporation.

d. The Executive Secretary shall be bonded by a recognized company.

Section 6. Treasurer.—Amend Section 6 by striking and substituting in lieu thereof the following:

Section 6. Treasurer.—The Treasurer shall perform the duties usually pertaining to that office, which shall include the following:

a. Receive and record all moneys paid the Association; and shall make disbursements as directed by the Board of Directors.

b. Serve as custodian of title deeds, business papers, bonds and other securities belonging to the Association.

c. Shall engage a certified public accountant to audit the books annually.

d. Shall submit to the Board of Directors a financial statement for the current year together with the report of the auditor.

e. Together with the Finance Committee, he shall prepare budget estimates for the next fiscal year for consideration by the Board.

f. The Treasurer shall be bonded by a recognized company.

ATTACHMENT #10

REPORT ON ADVERTISING IN MOSQUITO NEWS

January 1, 1960 through December 31, 1960

The figures below represent transactions during the calendar year 1960, for advertising in four numbers, Volume 19, number 4, and Volume 20, numbers 1, 2 and 3. (December 1959 and March, June and September 1960).

Number of active accounts	33
Number of Pages of Advertising	88
Receipts	3,203.86
Expenses:	
Postage, telephone, telegrams, printing, rate sheets, envelopes, letterhead	112.50
Honorarium for Stenographer	10.00
	122.50

ATTACHMENT #11

REPORT OF THE NATIONAL ADVISOR

The precise duties of the National Advisor have never been established. The position is an appointive one and was established in 1951 following a conference in Washington, D. C. The functions of the National Advisor were then described as, "an advisor to the Officers and Directors on procedure; a coordinator and Washington representative." The position was created to main-

tain the services of H. H. Stage as an active party in the affairs of the Association.

When Harry Stage left the Department of Agriculture in 1954, the position became vacant and Robert L. Vannote was appointed by President Dorer and approved by the Board to fill the position. Reappointment has been made by each incoming president.

Since 1954 the duties of this position have expanded to include special assignments by the President and advisory services to the membership and agencies interested in promoting mosquito control. If and when the Association expands to the point of a paid staff, certain functions of the National Advisor might well be undertaken by a Field Representative.

The National Advisor makes no effort to create activity. As the function is advisory, the services of the office are available to the Officers, Board members and the membership.

Due to the transition taking place in 1960, the Officers of the Association requested little service from the National Advisor. In association with the President, a review was made of the business sessions of the 1960 meeting and schedules and procedures suggested for the 1961 meeting. Whenever advice or suggestions seemed to be in order, the National Advisor was active.

Correspondence with control agencies and workers in the field continued to be an enjoyable part of the duties and it is felt that such service advances the reputation of the Association and is a stimulus for new members. The National Advisor attempts to keep advised of mosquito control activities throughout the country as a clearing house for control information.

ATTACHMENT #9

BUDGET—SCHEEL

	1958	1959	1960	1960 Budget
Dues and subscriptions	$5904	$7453	$7012	$7200
Advertising	2349	3711	3255	3600
Back issues	70	208	35	....
Reprints	1378	1179	1800	1000
Good Neighbor	530	590	20	500
Bulletins	56	6	13	200
Mailing lists	34	145	90	....
Exhibits	1678	1350	1500	1500
Sale of pins	....	81	72	....
Miscellaneous	....	43	5	....
Totals	$11,998	$14,766	$13,857	$14,000

DISBURSEMENTS

	1958	1959	1960	1960 Budget
Prints and reprints	$10,951	$ 9,342	$13,320	$11,200
Office supplies and expenses	372	304	295	..
Postage	182	452	411	..
Fidelity bond	5	5	24	..
Travel	500	500	500	500
Purchase of emblems	193	..	..	..
Examining Treasurer's Report	75	75	100	
Refund to subscribers	4	10	18	
Bank charge	3	3	6	725
Checks returned	27	..	15	
Exhibits	..	325	304	
Conference expenses	..	100	..	70
Desk and typewriter	..	..	104	200
Totals	$12,312	$11,135	$15,800	$14,500

PROPOSED BUDGET—1961

RECEIPTS		DISBURSEMENTS	
Dues and subscriptions	$7,500	Editor	$10,000
Advertising	3,000	Reprints	600
Reprints	800	Treasurer	350
Back issues	200	Executive Secretary	300
Exhibits	..	Membership	150
Good Neighbor	900	Public Relations	..
Savings account interest	120	Good Neighbor	25
		Advertising Manager	125
Total	$12,520	Librarian	..
		Bibliography	20
		Pres. Contingency, Annual mtg.	100
		Honorarium for clerical assistance to offices of: Exec. Sec., Treas., Editor, Adv. Mgr., Nat'l Advisor	250
		Traveling	600
		Total	$12,520

ATTACHMENT #12

REPORT OF EXECUTIVE SECRETARY FOR 1960

Association business has become so voluminous it was no longer practical to do it at the Mosquito District office. Except for casual clerical assistance and the use of some of the District's office equipment and storage space, all activities related to the Executive Secretary's office are being done at home by Mrs. Raley. To date the change has only required the purchase of a desk and typewriter, which was approved by the Board through the mail. A suitable filing cabinet, desk light, chair and miscellaneous stenographic aids are the only other items needed that will require an outlay of funds.

The consolidation of business activities approved at Boston has been completed. All back issues of *Mosquito News* and miscellaneous publications housed at Barnegat, N. J., were shipped to Selma late in the year. A letter of thanks and appreciation for many years of devoted service to the Association was sent to Mr. Henderson. Suitable acknowledgment from the board by the President is recommended. Earlier in the year the stock of bulletins arrived from Chris Williamson's office along with a complete record of sales and receipts. Thanks have already been expressed from this office and a letter from the Association would be in order.

The only business conducted by mail that has not been approved by the Board is the acceptance of new members. Each request for affiliation with the organization was accepted and placed on the mailing list for *Mosquito News* as it arrived. Formal approval by the Board is required to make the members official.

Mr. William Thoms retired November 31 from his position at Middlesex County Mosquito Extermination Commission. A letter of resignation as Assistant Treasurer of the Association was acknowledged with regret and a wish for many years of enjoyable loafing.

Letters were received from the very nice ladies whose valuable services were recognized with a small monetary gift. Little of the Association's business would be accomplished without their unselfish help.

The AMCA exhibit is ready and waiting in Florida to be shipped to the next user. As in the past the only requirement for using the display is payment of freight to your location and proper storage until a request is received for shipment.

Texas has now joined the ranks of State Mosquito Control Associations. A letter from Mr. Vieser brought word that the Gulf Coast MCA would expand into a state-wide organization on January 1, 1961. He has the honor of being the first president of the new association. All AMCA members should make a particular effort to attend the joint meeting with the Texas group in 1962 at Galveston.

Requests were received from many sources for information about our Association. Some of these were National Academy of Sciences; National Science Foundation; Graduate School of Business and Public Administrators; Cornell University; Encyclopedia of American Associations, and Office de la Recherche et Technique Outre-Mer, Paris. All were interested in material suitable for publication in directories. Another that may be of particular interest to members was from the Library of Congress for material to include in A Guide to U. S. Indexing and Abstracting Services in Science & Technology. A complimentary copy of the pamphlet was forwarded to Helen Sollers.

Mosquito News is now being mailed to all 50 states except West Virginia. A check of the list January 24 showed a total of 1178 accounts in the U. S. with a high of 193 in California and only 1 in Idaho and Mississippi. There were 497

accounts in 104 countries outside the U. S. As classified in this office 1197 accounts are members, 478 subscriptions. Within this total of 1675 there are 2 Life Members, 5 Honorary Members, 24 Exchange subscriptions and 114 Good Neighbors.

Unpaid accounts continue to be a problem every year. Each received at least 4 free issues and as yet requests for payment or return of the volume have produced little concrete return. The 89 accounts still unpaid for 1960 will be cancelled before the March issue is mailed.

Throughout the years a good deal of information and records on Association affairs have accumulated in the Executive Secretary's office. Any and all of this is available for any activity that will benefit the organization. Take advantage of this reference as you start committee assignments or other Association projects. Every effort will be made to answer requests promptly and as factual as possible. Copies of your letters on Association affairs will be appreciated too.

ATTACHMENT #13

RESOLUTIONS PASSED BY THE AMERICAN MOSQUITO CONTROL ASSOCIATION AT ITS ANNUAL MEETING, FEBRUARY 1, 1961

#1. WHEREAS, this joint and concurrent meeting of the American and California Mosquito Control Associations has been skillfully planned and conducted by our hosts, the Orange County, Southeast, Ballona Creek, Antelope Valley, and Compton Creek Mosquito Abatement Districts and their trustees and employees, with the assistance of various groups, official and nonofficial, now therefore

BE IT RESOLVED, that we do hereby express to these host agencies and persons our sincere thanks for the excellent program and the cordial reception we have enjoyed under delightful conditions.

#2. BE IT RESOLVED, by us the members of the American and California Mosquito Control Associations, that we hereby express our appreciation to the officers and committees of both associations for a fine job well done in making this joint meeting in 1961 at Disneyland, California, an outstanding success, and we particularly thank the Boards of Trustees of the several hosting Mosquito Abatement Districts for their special hospitality on the evening of January 30, 1961, to our Trustees and Commissioners.

#3. WHEREAS, the exhibitors at this joint meeting of the American and California Masquito Control Associations have done much to make this joint meeting of the AMCA and CMCA at Disneyland in California a success, partly through their informative exhibits and partly through their financial assistance, now therefore

BE IT RESOLVED, that we hereby express to them, individually and collectively, our appreciation of their courtesy and assistance, and we do particularly extend to Willys Motors our appreciation of its special hospitality hour for all members and guests, and

BE IT FURTHER RESOLVED that the Executive Secretary of the American Mosquito Control Association be requested to send individual copies of this Resolution to each exhibitor.

#4. BE IT RESOLVED, that the Executive Secretary of the AMCA be requested, on behalf of both the AMCA and the CMCA, to extend by appropriate means our thanks to the management and employees of Disneyland Hotel for the excellent accommodations and the courteous, unobtrusive, and efficient service rendered our members at this joint meeting.

#5. WHEREAS, many of those present at this joint meeting of the AMCA and the CMCA have come from considerable distance to be in attendance, whether as delegates or vistors, or as specially invited speakers, now therefore

BE IT RESOLVED, that we express to them our pleasure at their presence here, that we wish them a pleasant journey home, and that we hope that they will grace our future meetings with their friendship, good counsel and wisdom.

BE IT FURTHER RESOLVED, that we also give our special thanks to those invited speakers who have brilliantly informed our membership.

#6. WHEREAS, during the past year both the AMCA and the CMCA have lost by death several of their valued members, some in the fullness of years and some cut off in comparative youth, now therefore

BE IT RESOLVED, that we do hereby pay tribute to our departed members, and recognize posthumously their public service. May the words of the Bible, "Well done, good and faithful servants," be their epitaph.

#7. WHEREAS, there is a steady increase in the number of oxidation lagoons for sewage treatment in many parts of the United States,

AND WHEREAS these lagoons are potentially and actually sources of mosquitoes,

THEREFORE BE IT RESOLVED that the AMCA expresses its concern over the necessity of proper construction and maintenance of these lagoons,

AND BE IT FURTHER RESOLVED that the Association encourage research to find methods for alleviation of mosquito problems in these lagoons,

AND BE IT FURTHER RESOLVED that copies of this resolution be sent to state health officers in each of the fifty states, and to the Secretary of the Water Pollution Control Federation.

ATTACHMENT #14

AMERICAN MOSQUITO CONTROL ASSOCIATION, INC. COMMITTEE CHAIRMAN AND COMMITTEE APPOINTMENTS FOR 1961

Approved by Board of Directors, February 2, 1961

National Advisor:
R. L. Vannote

Editorial Staff, Mosquito News:
Donald L. Collins, Editor
Helen Sollers, Associate Editor
Helen Louise Durkee, Associate Editor
William C. McDuffie, Associate Editor
Austin W. Morrill, Jr., Associate Editor

Publication of Mosquito News:
K. L. Knight, Chairman
L. E. Rozeboom
Harry D. Pratt
E. A. Philen
Gordon E. Smith

Adverstising:
F. P. Creadon, Chairman and Advertising Manager, *Mosquito News*
Eugene J. Gerberg
Gardner McFarland

Miscellaneous Publications:
C. T. Williamson, Chairman and Business Manager
C. Donald Grant
William S. Murray
Harold F. Gray

Legislation:
Wayne Miller, Chairman
R. L. Armstrong
Herbert Knutson
Gardner McFarland
R. E. Dorer

Research and Development:
A. W. A. Brown, Chairman
A. Ralph Barr
R. C. Wallis
L. D. Beadle

Finance and Policy Council:
Charles F. Scheel, Chairman
Lester W. Smith, ex officio
T. G. Raley, ex officio
George Carmichael
W. E. Bickley
A. F. Geib
D. W. Micks

Committee on Bylaws:
A. J. Rogers, Chairman
K. D. Quarterman
R. A. Hedeen
Hugo Jamnback
Chester Robinson

Committee on Public Relations:
William W. Warner, Chairman
John A. Rowe
B. R. Evans
P. Bruce Brockway, Jr.
E. Elwood Lynch
R. M. Bohart
Gene R. Defoliart
Wm. E. Beckel
Bailey B. Pepper
Alan Stone
Fred H. Stutz

Committee on Membership:
A. W. Buzicky, Chairman and all regional directors

Committee on International Exchange and Good Neighbor Club:
Ernestine B. Thurman, Chairman
R. F. Darsie, Jr.
H. D. Newson
Brian Hocking
Donald R. Johnson
John E. Scanlon
J. A. Kerr
R. F. Fritz

Nominating Committee:
D. M. Jobbins, Chairman
Marshall Laird, Canada
Richard O. Hayes, North Atlantic
J. Melton Williams, South Atlantic
Franklin Wray, Northeast Central
Joseph E. Webb, Southeast Central
Glen C. Collett, Northwest Central
Gaines W. Eddy, North Pacific
Austin W. Morrill, Jr., South Pacific
Pedro Galindo, Mexico, Central and South America
Richard Eads, Southwest Central

Possible Affiliation with AIBS:
George L. Hutton, Chairman
F. G. Favorite
W. C. McDuffie

Program:
Don W. Micks, Chairman and all regional directors

Resolution Committee for Galveston Meeting:
John Hughes, Chairman
O. P. Breland
E. Chester Robinson
Jim McNeill

Historical Committee:
Dismissed with thanks.

ACTIVITIES OF THE NATIONAL MOSQUITO CONTROL-FISH AND WILDLIFE MANAGEMENT COORDINATION COMMITTEE

PAUL F. SPRINGER [1] AND ROBERT L. VANNOTE [2]

The National Mosquito Control-Fish and Wildlife Management Coordination Committee arose as an outgrowth of the Symposium on the Coordination of Mosquito Control and Wildlife Management held in the U. S. Department of the Interior, Washington, D. C., on April 1–2, 1959. This symposium was sponsored by the American Mosquito Control Association, the Bureau of Sport Fisheries and Wildlife of the U. S. Fish and Wildlife Service, The Wildlife Society, the U. S.

[1] U. S. Fish and Wildlife Service, Laurel, Maryland.
[2] Morris County Mosquito Extermination Commission, Morris Plains, New Jersey.

Department of Agriculture, and the U. S. Public Health Service. The persons who attended this highly successful meeting recognized the need for the development of means whereby workers in mosquito control and fish and wildlife management might better complement one another in the execution of their respective programs. Accordingly, they passed the following resolution:

"WHEREAS it is the opinion of this symposium that coordination between mosquito control and wildlife conservation is most desirable: Now, therefore, be it

RESOLVED, That this Symposium recommended the formation of a national joint committee consisting of three members representing wildlife conservation and three members representing the mosquito control interests, consisting of one member from the U. S. Department of Agriculture, one member from the U. S. Public Health Service, and one member from the American Mosquito Control Association; and be it further

RESOLVED, That this committee organize as soon as practicable after approval by the Federal interests involved, for the purpose of investigating the avenues of coordination between mosquito control and wildlife conservation, particularly in respect to research and operations." Robert L. Vannote, National Advisor of the American Mosquito Control Association and Secretary of the Morris County Mosquito Extermination Commission, Morris Plains, New Jersey, in his capacity as secretary of the Symposium, was asked to arrange for the formation of a committee and the holding of an organizational meeting.

The following representatives to the Committee were appointed by the sponsoring agencies of the Symposium: Ira N. Gabrielson, President, Wildlife Management Institute, Washington, D. C.; A. W. Lindquist, Chief, Insects Affecting Man and Animals Research Branch, U. S. Department of Agriculture, Beltsville, Maryland; Kenneth D. Quarterman, Chief, Technical Development Laboratories, Communicable Disease Center, U. S. Public Health Service, Savannah, Georgia; E. A. Seaman, Advisor on Fish and Wildlife Conservation, Office of the Provost Marshal, U. S. Air Force, Washington, D. C., and Secretary-Treasurer of the American Fisheries Society; Paul F. Springer, Chief, Section of Wetland Ecology, U. S. Fish and Wildlife Service, Patuxent Wildlife Research Center, Laurel, Maryland, and Robert L. Vannote.

The first meeting was held on January 29, 1960, in the Department of the Interior, Washington, D. C. Robert Vannote was elected chairman and Paul Springer was elected secretary. At this meeting the name *National Mosquito Control-Fish and Wildlife Management Coordination Committee* was officially adopted and the following Committee objectives were established:

1. To coordinate mosquito control and fish and wildlife management policies on national, state, and local levels.
2. To gather and disseminate relevant information and suggest standards on mosquito control techniques consistent with sound fish and wildlife management objectives.
3. To gather and disseminate relevant information and suggest standards on fish and wildlife management techniques consistent with sound mosquito control objectives.
4. To stimulate needed research and demonstration projects relating to mosquito control and fish and wildlife management practices.
5. To sponsor suitable meetings to further the purposes of this Committee.
6. To cooperate with agencies, organizations, and all others whose activities and interests may relate to those of this Committee.

Subsequent to the organizational meeting, four additional meetings have been held at approximately 3-month intervals. At these meetings major attention has been given to determining suitable Committee projects and how they could be implemented. A throw-away type brochure is being prepared to show: (1) the need and desirability of coordinating mosquito control and fish and wildlife management, (2) the means whereby coordination can be accomplished, (3) the sources of information on coordination, and (4) the research needed to improve coordination. Also, the Committee is outlining a manual that will describe coordinated mosquito control-fish and wildlife management practices in greater detail. Published and unpublished reports as well as the experience of field workers will be utilized in writing this manual. Completion of this work will enable the Committee to determine areas where additional information is needed.

Recently, a listing was prepared of current research, demonstration, and liaison programs on mosquito control-fish and wildlife management problems. This will be kept up to date to serve as a directory of persons and groups who are working on specific problems in this field. To fill in gaps in this directory and to obtain an over-all view of research and/or demonstration needs throughout the country, a questionnaire is being sent to all agencies concerned with mosquito control and fish and wildlife management.

Often it is noted that study is conducted on one phase of mosquito control or of fish and wildlife management but that the information or practice developed cannot be applied immediately since corresponding study has not been conducted on the effect of its use in the other field. To help correct this situation, a letter will be sent to all major agencies granting funds for research, calling their attention to this type of short-coming and urging that they seek a solution insofar as the problem relates to studies financed by grant monies.

Another field in which the Committee believes it can help coordinate activities is that of insecticidal use. It has been observed that the chemicals and dosages recommended for mosquito control vary considerably in different parts of the country. At times, the rates of application used

are above those required to obtain satisfactory control. In addition to being uneconomical and to presenting potentially greater hazards to fish and wildlife, there is evidence that such use may speed up the development of mosquito resistance to chemicals. The Committee believes that there should be greater adherence to the basic recommendations of the U. S. Public Health Service and the U. S. Department of Agriculture and is planning to call attention to this through editorials, articles or notes in Mosquito News, and in the proceedings or publications of State and regional mosquito control associations.

Since its beginning, the Committee has sought to promote better understanding in the fields of mosquito control and fish and wildlife management by answering questions on problems and by supporting, in several instances, the development of coordinated investigational programs. Liaison has been maintained with the Interdepartmental Task Force on Water Resources Development in Relation to Mosquito Control in order that there may be no overlapping of effort. Because of the enthusiasm with which the 1959 Symposium on the Coordination of Mosquito Control and Wildlife Management was received, consideration is being given to holding a second symposium. Since the first meeting was restricted largely to problems in the East, it has been suggested that the next meeting should deal with the situation in the West. The Committee welcomes further views on this as well as on other matters within the scope of its objectives. To the extent of its ability, it stands ready to assist all who are interested in the coordination of mosquito control and fish and wildlife management programs.

FOR YOUR CONVENIENCE

The Executive Secretary's Office

Post Office Box 278, Selma, California, Is Now the Address for:

Payment of Dues and Subscriptions:

Statements are now being mailed from Selma for unpaid 1961 accounts. As the statements for 1962 are sent from this office it will be assumed your cancelled check will be sufficient acknowledgement of payment. Membership cards and/or receipts will be sent only on request.

Orders for Association Bulletins:

Bulletin 4, "Organization for Mosquito Control" is now available at $2.00 a copy. Appendix B, "Sources of Information about Organized Mosquito Control," is a valuable reference for everyone interested in the location of established programs.

Bulletin 2, "Ground Equipment and Insecticides for Mosquito Control" is still available at $2.00 a copy.

Bulletin 1 and Bulletin 3 are out of print. A third printing or a revision of the aircraft bulletin is being considered. Practical means of reproducing the bulletin on experimental techniques are being explored.

Orders for Back Issues of Mosquito News:

All issues are available except, Vol. 1, No. 4; Vol. 3, No. 1; Vol. 11, No. 1; Vol. 20, No. 1. "Gifts" of any spare copies of the missing numbers will be welcome. If you have extra copies of the issues needed here why not trade them for other missing numbers in your set.

Early Notification of an Address Change:

Rerouting *Mosquito* News is a slow process. The new idea that you might have used to advantage during the mosquito season may not arrive in time. Paying postage to the vacated address, back to Selma and on to the new location is expensive too. Information on your new assignment will be appreciated by Austin Morrill for *News* and *Notes*.

Orders for Association Lapel Button:

The gold and blue design showing a mosquito with wings extended and suitable lettering is available at $1.50. The screw post can be attached to any type of material with little effort.

Inquiries on any and all Association activities can be addressed to Selma; however, time will often be saved by checking the inside front and back covers of *Mosquito News* for more direct contact on

Publication of *Mosquito News* and Advertising in *Mosquito News*.

Plan now for a visit to the great state of Texas in March 1962. The joint meeting on the 5, 6 and 7th with the new statewide Association will be a rewarding experience. Texas hospitality is of course taken for granted, but ample time is being provided for learning about mosquitoes and their control.

The dates for the 1962 California Mosquito Control Association's meeting are January 29–31. Write to David E. Reed, P. O. Box 125, Firebaugh, California for particulars. Other state and regional meetings of interest to mosquito workers will be announced in future issues of *Mosquito News*. Take an active part in those you can attend.

New members and agency subscriptions to *Mosquito News* are always welcome. A. W. Buzicky, Chairman Membership Committee, 797 Raymond Ave., St. Paul 14, Minn. will be happy to supply any number of application forms you need. Even one new account from each member would make Al very happy.

MEMBERSHIP LIST

The last time the membership list was published in *Mosquito News* was in March, 1953 (Volume 13, No. 1) with a supplement in March, 1954 (Volume 14, No. 1).

Apparently most AMCA members have no fixed abode. The insinuation that they just can't pay their rent, and therefore have to be always on the move, is we insist, not exactly true. We prefer to think that the abilities of our members are in demand all over the world, in malaria control, research on yellow fever, research on various other mosquito-borne diseases, research on mosquito control techniques and just plain research on mosquitoes.

For these reasons, a membership list, with addresses, is out of date before it appears in print. Nevertheless we have been assured by many members that it serves a useful purpose. Therefore, the Board of Directors has authorized the compilation and publication of a new list of AMCA members and their addresses in some issue of the present volume of *Mosquito News*. We plan to publish this list in the September number. We suggest that any member who expects his address to change, and who knows what his new address will be, should inform the Editor if he wishes a new address to appear in the list. Otherwise each name and address will be the same as on the addressograph plate used in mailing *Mosquito News*.

The advertisement for the Potts Mist Blower, on page VII of the March, 1961 *Mosquito News* (Vol. 21, No. 1) should have carried the following statement, with Mr. Potts' address: "For further details and other information address Mr. S. F. Potts, Box 51, Crawford, Mississippi."

NEWS AND NOTES

AUSTIN W. MORRILL, JR.

DON MURRAY, WHO IS SECRETARY-TREASURER OF THE CALIFORNIA MOSQUITO CONTROL ASSOCIATION, has just released a report on the financial returns from the annual meetings in Anaheim and we know all you financial types will be glad to know that We Made It! We came out in the black and enough left over (about) for postage. H'ray for the Committee!

THE VIRGINIA MOSQUITO CONTROL ASSOCIATION'S FOURTEENTH ANNUAL MEETING was held February 23 at the Admiralty Motel in Norfolk and included so many goodies that we would have to reproduce the entire program to present them all to you. HARRY PRATT reviewed the Training Aids and programs offered by the C.D.C. and other speakers slated from abroad (in Virginia that means from Outside Virginia) were JOHN FLUNO, PRES. BICKLEY, CHARLES GERHARDT, BOB VANNOTE, HAROLD RUSSELL, CAPT. DON MACCREARY (USNR) and GEORGE HACKWORTH. Their subjects ranged from the salt marshes of New Jersey to the Caribbean and took in new insecticides and the new granular form of an old insecticide, paris green, applied from the air.

ILLINOIS MOSQUITO CONTROL ASSOCIATION came next with their annual meeting on March 9 and 10, in Urbana, which was attended by over sixty people. LEO MICHL is the new President and BOB HEDEEN, who noted that "there was very little milling about in the halls during sessions" . . . a sure sign of good papers . . . is the new Vice-President. The theme was "Mosquito Control and the Population Explosion" but Bob didn't say whose population explosion, ours or the mosquitoes'. Both, we guess.

THE UTAH MOSQUITO ABATEMENT ASSOCIATION'S MEETING was held 17 and 18 March in Farmington, Utah, and was also attended by over sixty people. Discussions centered on survey methods, education and research, with papers by GEORGE KNOWLTON, LEWIS NIELSEN, LEWIS FRONK, GLENN COLLETT, JAY GRAHAM, EARL JENNER, out-of-staters from *USPHS* in Greeley, Colorado, including ARCHIE HESS, JIM SMITH, AND FRED HARMSTON, and Californians DICK PETERS, TOMMY MULHERN, DON GRANT AND DON MURRAY. Dick was also speaker at the banquet, with the topic of vector control programming, and we hear he commanded the attention of the multitude despite the usual wonderful and plentiful Utah food they had just enjoyed. Dick would no doubt have commanded even greater attention had they known that within twenty-four hours he was to shake down Reno for a jackpot in one of Those Places. Dick, all innocence, was standing by the strange machine wondering why someone didn't answer that damned phone, when the pretty lil gal in cowgirl outfit came dashing up with the sack of nickels. George Knowlton is the new President of the Utah Association and Glenn is V.P.; Jay Graham got stuck with the work-horse deal of Secretary-Treasurer.

NEW JERSEY'S MOSQUITO EXTERMINATION ASSOCIATION'S FORTY-EIGHTH ANNUAL MEETING was held at Atlantic City on 28, 29, 30 and 31 March and was, as usual, a Little League AMCA meeting, only not so little at that. We can't begin to list who-all was there on the program, let alone who attended, but again the subject of surveillance and research dominated many of the sessions, with much of the latter dwelling on aerial applications and work with the new chemosterilants, resistance-deactivators and other attempts to get around the chemical insecticide bottleneck. Cobalt 60 and stuff. TONY BROWN AND A. S. WEST came down from Canada to attend and we wish they could come to *all* the meetings!

THE ENTOMOLOGY COMMITTEE AND THE OPERATIONS COMMITTEE OF THE CALIFORNIA MOSQUITO CONTROL ASSOCIATION really kept people hopping in March and April. On March 24, at LES BRUMBAUGH'S district operations area and offices, a demonstration of equipment was held, which included an aerial spraying demonstration by helicopter in an adjoining alfalfa field where the helicopter pilot came about in such tight turns and held the chopper up on its edge so long while making them and at such low altitudes that some of us were all for ducking for cover and letting the Aedes-nigromacs fend for themselves. Another aerial demonstration was held, this time in a purely air show, on 24 and 25 April at the University of California at Davis. Meanwhile, the annual entomology seminar was held on 21 and 22 April at San Jose State college. STAN CARPENTER gave a fascinating account of his first year's studies in the High Sierra, including many observations on such species as *Aedes communis* which made us think of BRIAN HOCKING and his revolving checkerboard light-trap and whether it would help here in making population counts. Stan didn't bear down on it, but the intriguing possibility danced before our eyes of a close survey tied in with pre-melt application of granules to specific areas which would later be attractive to fishermen and campers. We think the Sierra Club ought to be interested in a small endowment for further studies here! Well, enough of fantasy. Stan's paper was a mighty valuable contribution to the knowledge of just what habitats are attractive to what species and emphasized again the need for research to guide practice.

THE FIRST SCHOOL DEVOTED TO TRAINING IN PEST CONTROL has recently been announced in Chicago. It will be known as the Elston School of Pest Control and Professor J. J. Davis, who fathered the idea of pest control courses in universities, will be the director. It will both train neophytes in the field and provide additional training for those already employed.

INCIDENTALLY, THOSE OF YOU WHO DON'T TAKE *PEST CONTROL* MAGAZINE (there *can't* be any such!) may want to write to JIM NELSON or to the Orange County (N.J.) Mosquito Extermination Commission, for a copy of their succinct little leaflet on the Ten Commandments of Mosquito Control. Their address is Barnegat, N. J. *Pest Control* reproduced them on page 16 of the April issue and that's why you may want to write to Jim, to get a copy, because it has some mighty good articles on mosquito transmission of disease and the value and methods of good water management. Sort of useful to have lying around your office when the taxpayer drops in.

NOW THAT HAWAII HAS RECEIVED TITLE TO WHAT WAS LONG A CLEAR POLITICAL FACT we got to noticing what other areas of the United States were still considered "overseas" assignments. And Lordhelpus, the new subscribers list came up with Naval Medical Research Unit No. 1, which the Navy, in its mysterious ways, assigns the address of Box 14, APO 63, C/o Postmaster, San Francisco. NAMRU-1 is in Berkeley.

THE SAME LIST INFORMS US of new members whom we'd like to welcome because they, like several we listed in previous issues, have long been very active in their State association and we'd just kinda assumed that they were AMCA'ers long ere this. So Welcome Aboard! to BILL RUSCONI, EMBREE METZGER, STEVE SILVEIRA and TOM SPERBECK. And an especial Welcome Aboard! to Professor NANZABURO OMORI who has long been a Good Neighbor and has now enriched our luster by adding his name to our rolls.

THERE'VE BEEN SEVERAL SHIFTS IN CALIFORNIA OF LATE and JOHN BRAWLEY is now manager of Butte County, which lifts him not only into the Sierra but into the upper bracket in acres; DICK FROLLI has taken Kings County, amalgamating with his old bailiwick, and a big change of pace, too. DAVE REED goes to Fresno-Westside, to carry on Leon Hall's fine work, which he is well equipped to do, we needn't add!

WE MOSQUITO CONTROL TYPES SEEM TO BE SORT OF RESTLESS ALL OF A SUDDEN . . . maybe we get that way from studying mosquitoes. Anyway, GEORGE BEVIER is now with USOM in Nicaragua. His address is that desk, Department of State, Washington 25, D. C. DR. MEL GRIFFITH has moved from Thailand to be Regional Malaria Advisor, TCM, American Embassy, New Delhi, India, and DR. C. BROOKE WORTH has left Johannesburg, S. Africa, for the Virus Laboratory, P. O. Box 164, Port-of-Spain, Trinidad. Meanwhile, JOHN MCDOWELL has returned from overseas and is now at the Training Branch of the Communicable Disease Center, Atlanta, Georgia. Welcome Home!

REECE SAILER caught the fever and took off for La Belle France, where he is now at 20 bis Rue Sadi Carnot, Nanterre, Seine, France, which sounds like a small restaurant with a good *vin du pays* to us. (Wacha doin', boys?) Everybody else this time has merely moved around inside the U. S. but some of the distances ain't so mere. BILL KRUGER has gone from Wisconsin to 156 Matheson Rd. in Columbus, Georgia; Capt. HARLAND FOWLER, JR., is now at the Medical Entomology Division of the U. S. Army Environmental Health Laboratory, Army Chemical Center, Maryland; AL RUDNICK has moved from Pittsburgh to the Hooper Foundation at the University of California Medical Center, San Francisco 22; and HARRY DAVIS merely moved from Pullman, Washington, to 1956 Beca St., Corvallis, Oregon. KEITH NEELY went from Hanford to 11454 E. Mines Blvd., Whittier, but GORDON SMITH really gets the prize for short moves. He moved across the room, from P. O. Box 2028 to P. O. Box 1725.

GEORGE BURTON, whose remarkable elephantiasis film strip we told you about a couple of sessions ago, has settled down to his new address which will now be U. S. Operations Mission to British Guiana, C/o American Consulate, P. O. 337 Georgetown, British Guiana. His new title is "Insect-borne Disease Specialist" and he says it's a helluva note when the disease specialists get insect-borne. He fearfully expects them to swoop down and carry him off to a dank den of *Wuchereria.*

THIS BUSINESS OF THE ADDITIVE ADJECTIVE IS GETTING MORE AND MORE COMMON AND IT REMINDS US OF A GUY WE HAD WORKING IN MOSQUITO CONTROL SUMMERS, ONE TIME. He was a butcher in the winter and had a blonde wife with china-blue eyes and a baby-doll expression, but about a hundred too many pounds since she had been the Clara Bow of the Butchershop. Anyway, we called her "Billie the Beautiful Butcher's Wife" and she used to say wistfully. "I don't know if you mean 'Beautiful Butcher' or 'Beautiful Wife', darlin'."

HELEN SOLLERS LEADS OFF OUR HONORS LIST THIS TIME, having been elected an honorary member of the National Society of India for Malaria and Other Mosquito-Borne Diseases. RAJINDAR PAL, who wrote the letter informing his fellow AMCA'er of her election, said, "I am delighted to inform you that our Society has elected you an Honorary Fellow . . ." and added, "The Society will indeed benefit im-

mensely from your association . . . as an honorary fellow . . ." We don't know if Helen plans to go to Delhi but it seems like a real good excuse and we hope to hear more. But get back in time for the next issue, Helen.

GEORGE HUTTON was honored by being elected Chairman of the Medical and Veterinary Section of the Entomological Society of America and, indeed, AMCA'ers made a clean sweep of the slate. CLUFF HOPLA is the new Vice-Chairman, W. M. ROGOFF is Secretary and LLOYD ROSEBOOM is member of the Editorial Board of the *Annals;* DON MICKS is member to the Editorial Board, Miscellaneous Publications, and LAFE EDMUNDS is member of the Advisory Committee. In looking over the minutes, in fact, studded with the names of DON COLLINS, ART LINDQUIST, KEN KNIGHT, OZ BRELAND, DON REES, DALE JENKINS AND BOB TRAUB, among many others from the rolls of AMCA, we can't help but withdraw our comment of last summer that all AMCA'ers "should be in Section D of ESA." Apparently all of them *are!*

COL. JOE WEBB, whose brief biography appeared in the March issue last year, is still at the Office of the Surgeon General, U. S. Army, but on March 2 of this year that old tardy eagle finally came and rested on his deserving shoulders. His friends had been sweating this out more than Joe ever did so there have been small celebrations all around the globe when the news spread. Another long-deserved elevation in rank occurred a while ago when LT. COL. TED BLAKESLEE finally succeeded in polishing the last bit of yellow tarnish off those oak leaves. Ted's expanding facilities at the Sixth U. S. Army Medical Laboratory, Ft. Baker, Presidio of San Francisco, are a marvel to behold and he will be glad to help any AMCA'er to behold them. He is rapidly getting in a position to rear a large assortment of species and to run resistance tests on samples from all over.

FRED SOPER received a nice write-up in the Shell Chemical Co's *SCAN* for March. We told you in our last issue that Fred was going to Pakistan to set up a new laboratory. It's for SEATO and will work on cholera. Fred's new address is: American Consulate General, APO 143, Box DAC, C/o Postmaster, San Francisco, and this means he'll be in Dakka, East Pakistan. We guess.

CHET ROBINSON has been in more newspapers recently than you can shake a stick at. With pictures. Illustrating the increasing usefulness and interest of his mosquito abatement (*cum* flies) to the citizenry. The *Oakland Tribune,* for one, domain of ex-Senator Knowland, gave extensive, illustrated coverage in March, and from all we hear a lot of people read about it, too.

THE DESPLAINES VALLEY MOSQUITO ABATEMENT DISTRICT, LED BY FRANK WRAY, has reported on its thirty-third season of operation in its usual scholarly way, and reports with a brave matter-of-fact attempt to hide their sorrow, that their biggest populations of adults last year were *Aedes vexans* (ouch!) and *Culex pipiens.* It didn't last, though, and they could proudly say that anyway they weren't breeding *inside* the district. We can sympathize.

WE HAVE JUST COME ACROSS A NOTE WRITTEN TO US BY PRESIDENT BICKLEY when we took over this column and it really threw a jolt into us. "Remember," he said, "they do not want just a glorified society column. They want short scientific notes and notes on new *practical procedures.* (The italics are Bick's) These are *next to impossible to get."* (These italics are ours.) Well, back to the drawing board. And, hey, you fellers! Come across, will you?

GEORGE THOMPSON'S JEFFERSON COUNTY (TEXAS) MOSQUITO CONTROL DISTRICT sent out an annual report (speaking of practical procedures) and a report for March 1961 which contain a good lot of information on first hand experiences with various types of automotive and heavy-duty equipment. In addition, George's tables provide a valuable breakdown on operating costs and work loads. We don't know about others, but it sure helps us a plenty to measure ourselves up against other folks and besides that it gives us good ideas. Incidentally, in further continuation of our previous remarks (ex-George) on flight ranges of *Culex salinarius,* George found that his migrating adults, which came in whenever temperatures permitted migration, appeared largely to be flying in from the other side of Sabine Lake, a minimum distance of 4 miles.

FOR WHO'S WHO THIS TIME LET US TAKE FIRST HOWARD GREENFIELD, who is a past President of the California Mosquito Control Association and an active present Member and also Manager of the North Salinas Valley Mosquito Abatement District. A Californian by the Grace of God and by selection, Howard was born in 1918 and attended Palo Alto High School and San Jose State College. He was in the Navy for four years (USNR) and had experiences in the Bureau of Vector Control of the California State Department of Public Health, and the Merced County (California) MAD before coming to the Salinas MAD as manager. His hobbies are photography and golf and he is a member of the Pacific Coast Entomological Society as well as the CMCA and AMCA. Howard is married and has two children and lives in Salinas, which is at the base of the Monterey Peninsula and mighty attractive to people, though no longer so to mosquitoes, thanks to Howard.

JOHN H. FALES was born in Washington, D. C. and attended public school there, graduating in entomology from the University of Maryland in 1936. Even then he was interested in mosquitoes and in research in insecticides for use

against them. Working with Goodhue and Sullivan on their aerosol bomb, now so omnipresent, Johnny was long saddled with the job of testing out for approval the hundreds of aerosol formulations seeking registration. (We called him Pete Grady.) In 1948, he went to Hawaii for several months on the Oriental Fruit Fly problem and how to keep it off airplanes headed for the mainland. Then back to the lab and *Musca domestica*. In 1960 he did field work on the new "face" fly which has been annoying cattle and alarming their owners of late. His interests include ornithology, photography, the history of aviation and a large collection of Maryland butterflies. And, though he didn't mention it, we can tell you that Johnny was responsible for a good deal of the present SOP on lab rearing of flies, mosquitoes and roaches, took a flier in learning the Russian language before that became a Thing to Do, and has been a hard working member for many years of the Washington Entomological Society.

HERBERT DALMAT came into his interest in tropical diseases during his Army career, though he may have had a few inklings of it when he studied for his BS at CCNY and his MS at Iowa State College. Herb was born in New York in 1919 and after the aforementioned schooling he went to Cornell as Instructor and also did further graduate study. From 1943 to 1946 he was in the U. S. Army Sanitary Corps and during this duty, in 1944 and 1945, then-Captain Dalmat was stationed in Natal, Brazil, in charge of aircraft disinsectization in the *Anopheles gambiae* control project. He was subsequently at AFTAC in Orlando, Florida, and at the Walter Reed Army Medical School, Department of Parasitology. In 1947, he joined the USPHS, with whom he still is, as Chief of Onchocerciasis Project, in cooperation with the Pan American Sanitary Bureau. He is now stationed at Bethesda in the Laboratory of Tropical Diseases of the NIH. Herb is a member of an impressive array of scientific societies, including the ESA, the American Society of Parasitologists, the New York Entomological Society, the Ent Soc of Washington, the American Society of Tropical Medicine and Hygiene and, naturally, US. He has published a whole lot of papers and does abstracts for Biological Abstracts, so his hobbies are contemplative ones, gardening and tropical fish. And *Gambusia?*

ADDENDUM: (All our news comes in the day after the deadline; this turned up *two* days after.) AMONG THE PROMOTIONS we should have mentioned 'way back yonder, is that of MAJOR WESLEY NOWELL, whose new address is 809th Medical Group, MacDill AFB 8, Florida (The AFB's now have *Postal Zones??*) Other new addresses: LOUIS OGDEN is at USPHS CDC, P. O. Box 73, Wenatchee, Washington, a move from Greeley; ROBERT ELBEL has left the Jamaica school for USOM, APO 146, San Francisco (where's that, Bob?); ROY CHAMBERLAIN has gone from Montgomery to CDC Virus and Rickettsia Sect., Atlanta 22; ARTHUR CHADWICK has *left* Atlanta for 5431 Davisson St., Kingswood Manor, Orlando, Florida; and DON AWAI has moved across from Honolulu 6 to 45-357 Akimala St., Kaneohe, Hawaii. Aloha!

William J. Buchanan

Mr. William J. Buchanan, Sanitary Engineer with the Malaria Eradication Training Center in Kingston, Jamaica, W. I., passed away on April 5, 1961. Death was apparently due to a massive heart attack. He had participated in the activities accompanying the initiation of a new Course at the Center the day before his death and there was no forewarning. He is survived by his wife, Helen, and by two children who have been living with their parents in Jamaica and by a son who is serving in the United States Armed Forces in Germany.

Mr. Buchanan joined the staff at the Center in February of 1960. He made a fine contribution in the developing of the portions of the curriculum under the subjects of Transportation, Administration and Spraying Practices. He will be keenly missed by staff and students at the METC by whom he was highly respected and appreciated.

Before coming to Jamaica Mr. Buchanan had been in charge of the South Cook County Mosquito Abatement District in Chicago, Illinois. Previous to that time he had been associated with the California Bureau of Vector Control and the Tennessee Valley Authority. He served a short assignment in Malaria work in French Indo-China in the early 50's.

Members of the Mosquito Control Association who knew Mr. Buchanan and his family will wish to join with us at METC in extending our heartfelt sympathies to members of his family.—Paul L. Rice, Associate Director, Malaria Eradication Training Center.

REVIEWS AND ABSTRACTS

HELEN LOUISE DURKEE

A PRELIMINARY ACCOUNT OF THE TRANSMISSION, MAINTENANCE AND LABORATORY VECTORS OF BRUGIA PAHANGI. By Edeson, J. F. B., Wharton, R. H., and Laing, A. B. G. Trans. R. Soc. trop. Med. Hyg. 54(5):439–449. 1960. 10 refs. *Brugia pahangi* occurs naturally in the domestic cat and dog and in several species of forest animals in areas where *B. malayi* is endemic. . . . Feeding experiments with a wide range of mosquitoes showed that *Armigeres obturbans* is a very efficient host. *Mansonia annulatus* is also a good host, but *M. uniformis* is less efficient, and *M. longipalpis* is a comparatively poor laboratory host. *M. (C)crassipes, Anopheles barbirostris, A. umbrosus,* and small numbers of *Aedes aegypti* and *Culex fatigans* also supported development to the infective stage. *M. longipalpis* and *M. annulatus* were proved to be vectors in nature.

The available evidence from blood and mosquito surveys in East Pahangi indicates that *B. pahangi* does not occur in man but the similarity of the microfilariae of *B. maylayi* and *B. pahangi* makes a species diagnosis from stained blood films difficult, especially if only a few micro filariae are present. However, with the very considerable reservoir in animals, the ubiquitous nature of the vectors and the evidence of successful transmission to a human volunteer, further search may well produce evidence of its occurrence in people living in endemic areas. Clearly, such people must receive infective bites and this parasite may play some part in the pathology of the disease even if it does not produce microfilaraemia.—Excerpts from authors' discussion and summary.

STUDIES OF THE BIONOMICS OF MOSQUITO VECTORS WHICH TRANSMIT FILARIASIS IN INDIA. I. ATTACHMENTS OF *Mansonia annulifera* AND *Mansonia uniformis* LARVAE TO HOST PLANTS OCCURRING IN PISTIA TANKS IN KERALA, SOUTH INDIA. By Burton, G. J. Indian J. Malar. 13(2/3):75–115. 1959. 54 figs. This is the first in a series of five papers, each of which is a distinct contribution to the ever-increasing stockpile of information on *Mansonioides.*

In this first paper, Dr. Burton outlines study procedures, describes in detail the photographic equipment used, and explains his methods of making the microphotographs. Having no histological apparatus available, he sectioned plant leaves and rootlets by hand with a sharp razor blade. Photographs include pictures of larvae attached to plants, cross sections showing airpockets in chambers of plant roots, and the general appearance of the host plants.

Table I is a brief one, showing the number of *Mansonia annulifera* 4th instar larvae still alive after 12 to 60 hours in natural tank (pond) water without host plants. The maximum survival time was between 51 and 60 hours; of 160 larvae, none was alive by the 60th hour. No pupation took place.

Descriptions of the means and methods of attachment by *M. annulifera* and *M. uniformis* to 12 host plants are given in interesting detail. When preparing to attach to a root, larvae backed in, upside down. Older larvae attached to roots, never to rootlets. Larvae when detached did not re-attach to the same place.

II. THE ROLE OF WATER HYACINTH (*Eichornia speciosa* KUNTH) AS AN IMPORTANT HOST PLANT IN THE LIFE CYCLE OF *Mansonia uniformis* (THEOBALD). WITH NOTES ON THE DIFFERENTIATION OF THE LATE EMBRYONIC AND NEWLY HATCHED STAGES OF *Mansonia uniformis* (THEOBALD) AND *Mansonia annulifera* (THEOBALD). Indian J. Malar. 14(2):81–106. 1960. 47 figs. 1 ref.

Water hyacinth in the Cochin area, Kerala State, was the preferred host plant for the attachment of larvae and pupae of *Mansonia uniformis* (Theo.). When *Pistia stratiotes* (water lettuce) was present, *M. uniformis* deposited its egg masses on *Pistia leaves.* Upon hatching, the larvae left the *Pistia* plants and migrated over to attach to the mud-covered roots of water hyacinth. The author attributes this movement to the habit of *M. uniformis* larvae to remain in mud. Because all of the aquatic stages of *uniformis* occur on water hyacinth, Dr. Burton feels that this plant should be considered of the utmost epidemiological importance wherever *uniformis* occurs.

The photographs illustrate attachment methods of *M. uniformis* as well as the development and structures of embryonic and first instar larvae of *uniformis* and *annulifera.*

III. FURTHER STUDIES ON ATTACHMENT OF *Mansonia uniformis* LARVAE TO HOST PLANTS OCCURRING IN *Pistia* TANKS IN KERALA, SOUTH INDIA. Indian J. Malar. 14(2):107–129. 1960. 43 figs. 2 refs. Larvae of *Mansonia uniformis* attached readily to the roots and rootlets of three grasses, and to the roots of an aquatic, leafy herb. Attachment of first instar larvae to the fine roots of an aquatic plant and to the fronds of another species of flowering plant is described, as well as the attachment of older larvae to the nodes and branches of stonewort and hornwort.

"It was established, after months of observations, that attachment to leaves is a *normal,* and not an unusual, form of attachment. . . . as an alternative to the root type of attachment for obtaining oxygen and giving up carbon dioxide."

There is described in some detail the oviposition habits of *Mansoniodes,* and the placement of egg masses on certain species of water plants.

IV. OBSERVATIONS ON LARVIVOROUS ACTIVITIES OF VARIOUS FISHES IN FILARIAL AREAS OF KERALA

STATE, SOUTH INDIA. Indian J. Malar. 14(2):130–156. 1960. 42 figs. 3 refs. Fourteen species of fish and the mosquito larvae found associated with them in the ponds were observed and reports made on the eating habits of the fish. The feeding habits of *Gambusia affinis* (obtained from the Malaria Institue of India, in Delhi) were compared with those of the naturally-occurring species. The photographic illustrations are interesting; they picture the fish feeding on attached and free swimming larvae and on pupae of *Mansonioides,* and on larvae of *Culex fatigans.*

V. FURTHER STUDIES ON ATTACHMENT OF *Mansonia annulifera* TO HOST PLANTS OCCURRING IN TANKS CONTAINING *Pistia stratiotes* IN KERALA STATE, SOUTH INDIA. Indian J. Malar. 14(3):191–218. 1960. 61 figs. 3 refs. Detailed studies were made on the attachment of *M. annulifera* to fourteen additional species of aquatic plants. During the course of these studies, the author collected data that again substantiated his contention that leaf attachment is normal; *M. annulifera* attached to leaves in seven out of the 14 species.

These five papers have been reprinted and bound together in a single, 145-page volume, which should be on every medical entomologist's bookshelf. The results of painstaking investigations are set forth in a clear-cut fashion. The style is excellent, the illustrations abundant, and the photography very good.—H. L. T. Durkee.

A WINDOW-TRAP HUT EXPERIMENT TO TEST THE EFFECTS OF DIELDRIN UNDER LOCAL CONDITIONS IN THE MERAUKE AREA (NETHERLANDS NEW GUINEA). By Assemb, J. van den. Trop. geogr. Med. 11:32–43. 1959. 14 refs. In the Merauke district, abundant populations of anophelines (mainly *A. farauti, A. bancrofti,* and *A. amictus hilli*) still persist though the area has been sprayed three times with dieldrin. A complete control of house-entering anophelines was obtained for about six weeks following spraying, but a decrease then started. After five months only 20 percent were killed. A sufficient kill (assumed to be in the order of 60 per cent) is thus obtained in a three-month period following spraying.

There were no signs of resistance to dieldrin. The daily mortality in *A. bancrofti* and *A. farauti* was estimated to be in the order of 30 percent. Cattle, fowl, and game animals, numerous in the district, are important as tending to keep anophelines away from man.

Under present conditions it must be considered impossible to eradicate the malaria vector (mainly *A. farauti*) by dieldrin indoor spraying only; it is also improbable that the vector's average expectation of life is cut down to a point below the length of the extrinsic cycle of the parasite, the main objective of every spraying campaign.

Nevertheless, dieldrin is of real value in malaria control, as may be concluded from figures given by Metselaar, although it is difficult to separate the effect due to dieldrin alone from that due to climatological influences, and to the administration of drugs.

The effect of dieldrin as referred to above can be explained by the fact that it kills only those anophelines which enter houses. As long as the insecticide is sufficiently active the daily mortality of house-haunting mosquitoes is far greater than the average daily mortality of the entire anopheline population. Assuming that more than half of all malaria infections are aquired indoors, the average mortality of these infective or potentially infective vectors should be computed on the basis of the number of house-entering mosquitoes, and not of the total anopheline population.

If a sufficient control can be achieved for three months per application, the results are likely to be improved if the frequency of spraying is increased. This, however, is economically impossible in this country, because of high labour costs and a considerable loss of productivity due to extremely low density of the population and the primitive transport. Under New Guinea conditions dieldrin has proved to be inferior to DDT as a residual insecticide.—Author's conclusions and summary.

INTERNAL DDE PRODUCTION BY NORMAL AND DDT-RESISTANT LARVAE OF *Aedes aegypti.* By Chattoraj, A. N., and Brown, A. W. A. J. econ. Ent. 53(6):1049–1051. 1960. 11 refs. Larvae of 3 DDT-susceptible strains of *Aedes aegypti* (L.) when exposed to 1 p.p.m. DDT for 24 hours, contained approximately one-tenth to one-quarter as much DDE as larvae of 3 DDT-resistant strains. However, in the naturally-tolerant Penang strain in which the DDT susceptibility levels had been varied by selection or relaxation of pressure, there was little correlation between DDT-resistance and DDE content.—Authors' abstract.

EFFECT OF ABSENCE OF SALIVA ON BLOOD FEEDING BY MOSQUITOES. By Hudson, A., Bowman, I., and Orr, C. W. M. Science 131(3415):1730–1731. June 1960. The salivary glands of *Aedes stimulans* (Walker) are the source of an antigen which produces typical bite reactions in men and laboratory rabbits. If the main salivary duct is cut, the reaction is not produced when the mosquito bites. Lack of saliva does not affect the intake or movement of blood into the midgut, nor does it prevent the development of eggs. The presence of an anesthetic component in saliva is suggested.—Authors' abstract. Editor's note: The excellent study referred to above was carried on at the Department of Biology, Queen's University, Kingston, Ontario, Canada, through grants to Professor Allen S. West. AMCA member Allen West has long been identified with research on mosquitoes and their blood meals. There are several worthwhile facets apparent in the present investigation, and we trust that lengthier reports will be forthcoming.

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